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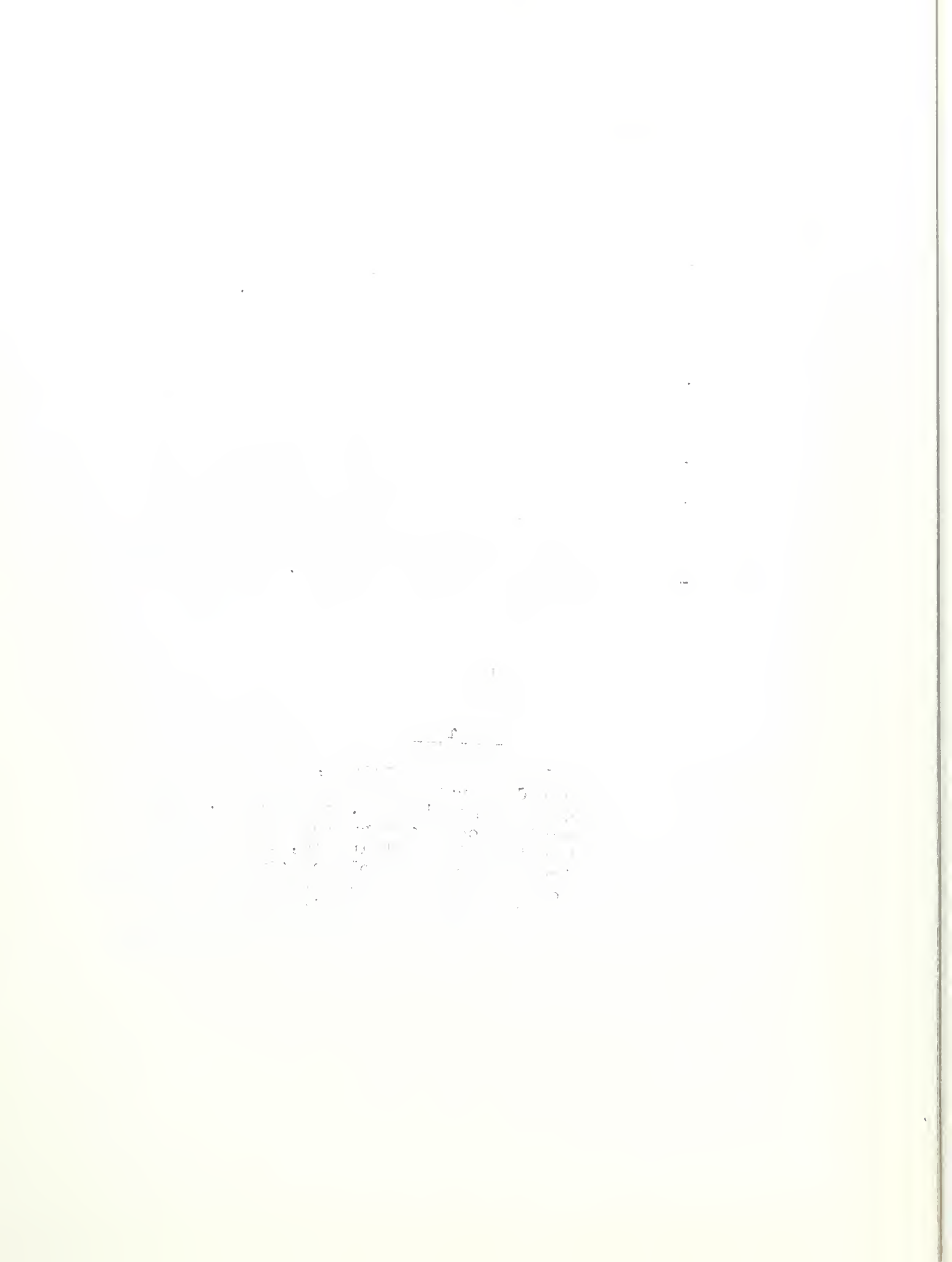

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CHAPTER 5 - ENGINEERING & MAINTENANCE

5.1 Introduction. For purposes of this report, research, design, and development have been grouped under the one general heading of "Engineering". Organizationally, separate engineering groups exist for the Machine Tool Corporation and the Fastener Division, and since their functions and operations differ so widely, separate and independent studies were made of each. A similar situation exists under the general heading of "Maintenance", which was assumed to include building and grounds maintenance, routine operational functions such as cleaning/janitorial services and the provision of utility services, and shop equipment maintenance. As discussed in greater detail later in this chapter, responsibility for the maintenance of shop equipment is completely separated from building and grounds maintenance. Accordingly, each was studied separately.

Obviously, any study of the engineering and/or maintenance functions could rapidly bog down in a mass of relatively insignificant detail. Without proper control, this could lead to inconsequential recommendations. Therefore, every effort was made to limit detailed analysis to those specific areas in which recommendations might bring the optimum benefit to the Corporation.

5.2 Engineering.

5.2.1 Machine Tool Corporation. The Engineering Department of the Machine Tool Corporation consists, at the present time, of a Head and four designer-draftsmen. The department is responsible for the design of new machine tool equipment, modernization of old or used equipment, design work in connection with the "SKY-PARK", and the preparation of quotations or estimates. Work is normally generated by the specific requirements of the customer and may range from the design of a highly intricate electronic control system to a relatively simple location and foundation design. Although the Head of the Department indicated that a "normal" work load (exclusive of time spent preparing quotations) would be distributed approximately 40% on new design and 60% on modernization work, there has been almost no new design work accomplished during the past twelve months. Typical jobs in the Engineering Department during

the past year included:

A. Design new main drive, feed and table bearings for a Niles vertical boring mill.

B. Redesign a 60 x 200 Waterbury file grinder to grind tapers.

C. Design larger spindle and bearings for a 28" Landis grinder.

D. Design a new oiling system and formica ways for a 6'x6'x30' Cincinnati planer.

E. Design a new drive system for a 100" Niles vertical boring mill.

A total of fifteen major and fifteen minor jobs were completed during the past twelve months of which approximately six were "fill-in" jobs on equipment scheduled for stock; the rest of the work resulted from customer orders. Some thought has been given to standardizing gear boxes, and the Company now has four 3-speed gear boxes that they consider as standard. These, however, are frequently modified to fit particular equipment or customer requirements. There appears to be little other opportunity for standardization.

A study of the Engineering Department files indicated that drawings are filed by drawing number, size of drawing and type of machine. The total files include approximately 10,000 new designs and 15,000 minor modifications of which approximately 7,000 are active and are retained in the Division office. Engineering data and quotations are filed separately by type of machine and by customer. Since most inquiries refer to a specific piece of shop equipment, and since only those persons working in the design office normally have access to the files, there is little problem of information retrieval.

One matter which would appear to warrant attention, however, is the definition and delineation of responsibilities. It is "generally understood" that Engineering has entire responsibility for new design work, and that the shop has complete responsibility for routine rebuilding work unless engineering services are specifically requested. The responsibility for modification work, how-

ever, is assumed jointly. As a result, no one supervisor can be held exclusively accountable. In work of this type where one relatively minor error could prove extremely costly, such a dual responsibility situation is highly undesirable. Problems, moreover, are not limited to the area of modernization. During the course of the study it was discovered that an out-of-town "SKY-PARK" customer was forced to send a representative to the plant to resolve a fundamental design error. This had been informally corrected by shop personnel but never communicated to the Engineering Department so that the design drawings could be corrected. There appears to be no restriction on shop correction of drawings nor requirements that errors be made known formally to Engineering. Official correction by the Engineering Department depends upon the effectiveness of communications between shop supervision and the head of the design staff.

Although it is assumed that the above-referenced case was only an isolated one and not representative of actual conditions, it does point up problems which could result from the lack of concise definition of duties and responsibilities.

5.2.2 Fastener Division. Research, development and product engineering are the responsibilities of one individual in the Division. Work in this area is basically limited to the adaptation of existing designs or the development of new ones to meet specific customer requirements. Coordination between Engineering and Sales is provided by a Technical Sales Representative at the plant. A designer-draftsman is currently assigned full time to drafting support; the greatest proportion of his time, however, appears to be devoted to maintaining a current file of record drawings. Filing, therefore, and its associated problem of information retrieval, was considered as the first important area for analysis.

Assembly, mounting and shop detail drawings are currently being prepared, usually in an 11" by 17" size. These are filed, in the drafting room, by basic components (i.e., blades, anchor plates, etc.) and by kind of fastener subdivided by variations of basic parts or components. An additional drawing file by customer is maintained in the technical sales office. Within each of these separate files, drawings are located in chronological order, based on either drawing number or order number.

Although the files are generally available to all key personnel of the Fastener Division, they are primarily used by only three or four people. Requests for information are frequently received without specific reference to type or characteristic descriptor. Requests are not usually of an urgent nature, but they can be received over the telephone thus placing, at these times, a premium on fast and effective information retrieval. A recent change in draftsmen coupled with the fact that each draftsman, apparently, has been permitted to establish his own filing procedures has accentuated the lack of a standardized, workable classification and information retrieval system. The existence of this problem is realized by Division personnel, and attempts are being made to devise some type of standard filing system. Unfortunately, this work has been frequently sidetracked by more urgent matters.

The importance of one standardized classification system can not be overemphasized. Although only limited direct monetary savings may be realized by the establishment of such a system, the indirect, unmeasurable savings resulting from improved customer relations and from improved internal efficiency would appear to be significant. Even though the advisability of recommending a proprietary retrieval system is questionable, it is believed that Company investigation of the Zatocoding System, along with other tried and proven methods, would be warranted. The characteristics of the existing information retrieval problem appear to be ideally suited to the Zatocoding System.

The study of filing and information retrieval problems pointed up a second significant problem area - standardization. Standardization has been accomplished in certain general areas such as types of fasteners, basic sizes within types, and metal inserts for the plastic SPRING-LOCK. But the overall Company policy stresses design to meet specific, and often detailed and peculiar, customer requirements. As a result, there are some fifty variations of the LINK-LOCK, approximately 115 combinations of the QUICK-LOCK, and over 1500 types of plastic SPRING-LOCKS of which 500 are currently active. A summary of Fastener Division products showing general areas of standardization as well as variations thereof is contained in Exhibit 5-1.

The number of variations, however, is not the only problem. The entire policy of custom-design is built around the abilities of one individual - the designer. Loss of this man, coupled with an inability to replace him

rapidly, could seriously jeopardize the entire operation. And unfortunately, no plan of action appears to be available in the event of such a circumstance. Accordingly, it would appear advisable for top management to make a detailed evaluation of the situation, and to define a long range course of action. Some alternatives which might be considered are:

A. Hire an assistant for the designer now and, through a suitable training program, develop an eventual replacement.

B. Limit the extent of future custom design, thus curtailing and de-emphasizing this customer service.

C. Study present products and, on the basis of sales volume or profit margin, reduce the range of fasteners to a few standardized ones which are sure money-makers.

The above alternatives are not intended to be all that should be considered, but are only representative of the type of approach that should be taken. Even though the situation does not appear to require any action at this time, the Company should plan now for any future eventuality.

5.3 Maintenance.

5.3.1 Building Maintenance. Responsibility for building maintenance, including such operating services as interior cleaning, provision of utilities (heat, light, power, etc.) and grounds maintenance, is assigned to the Building Superintendent, organizationally located in the HMC Corporation. This is a real estate holding corporation which administers fourteen buildings in the area. Four of these buildings are wholly or partially out-leased to the State of New York for offices and storage area. The normal maintenance staff consists of five full-time (and one part-time) employees who, although they have specialties such as machinist, heating plant operator, etc., are generally proficient in several trades. This staff is augmented by a regular cleaning force of 41 women and men who work either a four or a six-hour per day shift, usua lly in the evenings. Additional help is borrowed from the production shops as required during normal working hours.

Specialty work such as elevator maintenance, roof

repair, window washing, road maintenance, and snow removal is performed under contract on an "as-needed" basis. Light, power and water are purchased, while heat is provided by oil-fired heating units located in the various buildings.

In view of the limited staff, no formal work planning, scheduling and control procedures are in effect, nor are elaborate systems considered necessary. Although adequate cost accounts are available to collect detailed maintenance cost information, there was no evidence that this information was used to any great extent either in budgeting or to control the cost and amount of maintenance work. Determination of the proper level of maintenance is apparently left entirely up to the Building Superintendent. The only area where maintenance standards are used is in the janitorial work. Here, cleaning standards published in "Building and Equipment Sanitation Principles and Practices" (J. Lloyd Barron, Albert J. Bauer - Association of American Soap and Gylcerine Products, Inc., 295 Madison Ave., N.Y.) are being used to establish individual cleaning zones and and to evaluate and control performance.

Typically, as-built drawings of buildings and utility services are not readily available to the maintenance staff, thus limiting its effectiveness in an emergency.

In view of the limited scope of maintenance operations - buildings, there are no major suggestions for improvement that can be made. Consideration might well be given to staffing the maintenance force with a limited number of representative building trades rates. This would reduce the necessity for being dependent, in cases of emergency repairs, upon personnel borrowed from the production shops. This matter, however, will be discussed further as part of a recommendation under Equipment Maintenance.

5.3.2 Equipment Maintenance. Responsibility for maintenance of installed shop equipment is assigned to the Shop Superintendent of the Machine Tool Division and to the Plant Superintendent of the Fastener Division. No formal preventive maintenance or overhaul/repair programs exist, nor was there any evidence that levels or standards of maintenance for shop equipment had been defined. Apparently, responsibility for keeping equipment lubricated and operating is placed at the operator level, while decisions concerning overhaul and repair are made by the Shop Superin-

tendent and/or Plant Superintendent. There is no doubt that the personnel operating the equipment are well qualified to perform routine operator maintenance in the Machine Tool Division. A qualified service force is available from the Machine Shop of the Fastener Division for this work. But without defined standards, there can be no way to control over or under-maintenance of this equipment. Unfortunately, cost records which might disclose instances of over or under-maintenance were not available.

Since equipment maintenance is only a secondary responsibility of production personnel, the extent and timing of maintenance is dependent upon the production schedules. This is further complicated in the Fastener Division by a lack of personnel with specific maintenance qualifications. As a result, help must be borrowed from the Machine Tool Division for major overhaul/repair work, subject once again to the work load in that shop.

The amount of installed shop equipment (refer to Figure 9-3 and Drawing #3) and the need to keep this equipment operating if production schedules are to be met suggests that preventive maintenance, overhaul and repair are of sufficient importance to warrant a full-time staff of personnel. With a properly planned program, this staff can be held to an absolute minimum. Assignment of full responsibility for equipment maintenance to the Building Superintendent would group all maintenance functions under one head. Augmentation of such a staff might well be planned to coincide with the limited increase in building trades rates suggested in Section 5.3.1 above.

5.4 Recommendations. It is recommended that:

1. The present analysis of possible classification and information retrieval systems be expanded to include consideration of the proprietary Zatocoding system, for the Fastener Division.

2. Consideration be given to developing an ultimate, long-range plan for product standardization for the Fastener Division.

3. Authorities and responsibilities of the Engineering Department and the Machine Tool Division be redefined, formally, to eliminate or reduce current conflicts. Such definitions should be included in position descriptions.

4. A system be instituted, which will not permit deviations from the blueprint specifications without formal approval from the Engineering Department.

5. Those persons required for building maintenance be assigned to the Building Superintendent to bring his authority more in line with assigned responsibilities.

6. Responsibility for maintenance of installed shop equipment be assigned the Building Superintendent, and that sufficient personnel be provided to the maintenance organization to accomplish this work.

No.	Fastener Type	General Description	Typical Applications	Standard Models		Variations (Special Designs)			Remarks
				Designator	Characteristics	Area of Variation	Details of Variation	No. of Variations	
1	LINK-LOCK	Positive-locking, springless latching device for use wherever preloaded closure is desired	Prefab jet-aircraft hangars, military transit cases, storage boxes	#1	Load carrying cap. to 4000# tension preloading up to 1500# pull-down pressure	Blades (primarily)	Dimensions Shape	4(1)	(1) Number of variations applicable to items numbers 1,2,3&4
				#2	Load carrying capacity up to 1000# tension preloading up to 450# pull-down pressure	Blades A. Plates K. Plates Assemblies Parts	Various Various Various Various Various	50(2)	(2) Number of variations applicable to items numbers 1, 2,3,4
				#3	Load carrying capacity up to 300# tension preloading up to 90# pull-down pressure	Blades A. Plates K. Plates Assemblies Parts	Various Various Various Various Various	50(2)	
2	LINK-LOCK (flush mounted)	(See #1 above)	(See #1 above)	#2	(See 1-#2 above)	Blades	Dim.,Shape	(1)	
				#3	(See 1-#3 above)	Blades	Dim.,Shape	(1)	
3	LINK-LOCK (spring loaded)	Similar to 1 above but with spring feature providing take-up for sealing surface irregularities	(See #1 above)	#2	(Same as 1-2 above)	Blades	Dim.,Shape	(1)	
				#3	(Same as 1-3 above)	Blades	Dim.,Shape	(1)	
4	HINGE-LOCK	Pressure hinge to provide for pressure tight sealing of hinged cover	Equipment cases Instrument cases	#2	Load carrying cap. to 1000# tension preloading up to 450# pull-down pressure	Blades A. Plates K. Plates Assemblies Parts	Various	(1) (2)	

Figure 5-1

No.	Fastener Type	General Description	Typical Applications	Standard Models		Variations (Special Designs)			Remarks
				Designator	Characteristics	Area of Variation	Details of Variation	No. of Variations	
4 (Cont'd.)				#3	Load carrying cap. to 300# tension preloading up to 90# pull-down pressure	Blades		(1)	
						A. Plates K. Plates Assemblies Parts	Various	(2)	
5	QUICK-LOCK	Spring-loaded, self ejecting locking device	Engine cowlings, access panels, gas tank covers, caskets, etc.	#7	700# tension & shear	Stud	Flush head	1	
							Oval head	1	
							wing head	1	
						Plate Receptacle	Thickness to be fastened	10	
						Screw-type Receptacle	Thickness to be fastened	3	
				#5	500# tension & shear	Stud	Flush head	1 (1)	
							Oval head	1	
							Wing head	1	
						Plate Receptacle	Total thickness to be fastened	9	
						Screw-type Receptacle	Total thickness to be fastened	5	
				#2	200# tension & shear	Stud	Flush head	1 (2)	
							Oval head	1	
							Wing head	1	Within limits - range of thickness appears to be standardized
						Plate Receptacle	Total thickness to be fastened	9	
						Screw-tyoe Receptacle	Total thickness to be fastened	4	116 various combinations

Figure 5-1
(Cont'd.)

No.	Fastener Type	General Description	Typical Applications	Standard Models		Variations (Special Designs)			Remarks
				Designator	Characteristics	Area of Variation	Details of Variation	No. of Variations	
6	ROTO-LOCK	Butt-joint springless panel fastener with ease of demountability	Shipping containers, caskets, portable shelters	#1	1400# tension, 2000# shear				A few variations
				#2	1000# tension, 1200# shear				
7	DUAL-LOCK	High load, positive-locking fastener	Military shelter, panel fasteners, large shipping containers	--	2500# tension				A few variations
8	SPRING-LOCK (metal)	Removable on piece blind fastener, self asjusting for various panel thickness	Inspection panels, rotary-brush fastener, shelf support, cabinet door strike etc.	1/8"	(stud diam.)	Wing hd.stud	(N/A)		
						Oval hd.stud	(N/A)		
				5/32"	(stud diam.)	Wing hd.stud	(N/A)		
						Oval hd.stud	(N/A)		
				3/16"	(stud diam.)	Wing hd.stud	(N/A)		
						Oval hd.stud	(N/A)		
				1/4"	(stud diam.)	Wing hd.stud	(N/A)		
						Oval hd.stud	(N/A)		
9	SPRING-LOCK (plastic)	Steel insert molded plastic spring lock	Refrigerator shelf supports, knobs		Wire insert	Heads	Per request of customer	(3)	(3) 300-400 active; 1500 on record
						Color	Per request of customer	~100	
						Material	Per request of customer	2 basic	
						Insert		9 basic	
								(24 sub)	

Figure 5-1
(Cont'd.)

CHAPTER 6 - PRODUCTION PLANNING AND CONTROL

6.1 General. Production planning and control may be considered as one of the keys to success for any manufacturing organization. Essential elements such as work-input control, job planning, work performance planning and estimating, job scheduling, material coordination, and work performance control through the review and evaluation of reports and the initiation of proper corrective action, all combine to make up the framework of an effective system. The degree to which each of these elements is formalized depends, to a large extent, on the size of the organization and the complexity of its operations.

In analyzing the manufacturing divisions, these element, and the degrees to which they were formalized, were therefore given primary consideration in the areas of Production Planning and Control, Material Control and Quality Control. For both the Machine Tool Division and the Fastener Division current procedures will be described and then analyzed in order to present supporting data for the recommendations.

6.2 Machine Tool Division.

6.2.1 Planning and Work Authorization. The manufacturing authorization consists of a customer order, or contract, calling for the repair, rebuilding or modernization of a particular machine tool. This generally sets forth, in some manner, the operating capabilities the re-worked machine must possess and/or the new features to be installed. Work determination and production planning commence with the initial analysis and inspection of a newly-arrived machine by shop supervision, and continues through the subsequent disassembly and detailed examination. A standard multi-form Production List (Figure 6-1) is utilized as the basic planning record, and on it are accumulated all information relative to planned work in the manner described below:

Each machine tool is assigned a work or job order number which appears on the Production List and will be used to identify the particular job, and each part pertaining thereto, as it proceeds through the various stages of

planned operations. As the machine is disassembled, major components and individual parts are inspected and examined by experienced machine tool rebuilders to determine the necessity for individual repair or replacement. Each part is tagged with a "job tag". The job tag identifies the part as belonging to the machine bearing the same work order serial number, is coded to associate it with a particular component of the machine, and contains the instructions for repairing the part, manufacturing another from it as a sample, and/or rough working sketches of machining operations required. All parts of the machine determined to require work or replacement are handled in this manner, while the remaining components and parts requiring only cleaning prior to return to the assembly area, are placed together in job order tagged tote boxes and dispatched to the cleaning center.

Concomitant with "job tagging" of the particular items, the Production List is prepared by a "write-up" man to reflect the accumulation of work necessary for the entire work order. Each job tag part is listed on the Production List, along with a description of the items, where the work is to be performed, and any amplifying remarks considered pertinent. In the instance of new components or parts being added to the machine, as in the case of modernization work, necessary blueprints are prepared by the Engineering Department, are marked with the job order number to which they pertain, are referenced on the Production List and serve the same purpose as a job tag. Requisitions are prepared by the write-up man for the purchase of necessary parts, approved by the shop superintendent and are forwarded to the Purchasing Department for procurement. Notation of this also is made on the Production List, and a copy of the requisition bearing the applicable job order number is utilized by the Shipping and Receiving Department to notify the appropriate assembly foreman or mechanic upon arrival of the ordered material.

The original copy of the Production List is sent to the Shop Superintendent's office (Production Office), while two copies are distributed to, and retained by, the foreman of the machine shop, and foreman or mechanic in charge of rebuilding the machine. The fourth, or file copy, is retained at the write-up desk where it can be maintained current as day-to-day additions or changes are precipitated by the rebuilding and reassembly operation as it progresses. Daily corrections to the original and all copies of the active production lists are initiated by the write-up desk,

but the accomplishment of the procedure on a timely basis appears to be the exception rather than the rule. The original in the Production Office is the master control copy, while the copy at the write-up desk acts as the working copy.

The Production List then, built up and distributed as described above, is utilized as a production order and simultaneously constitutes the prime production control paperwork.

6.2.2 General Scheduling. General Scheduling of the job orders through the machine shop, and ultimately back to the area of reassembly, is accomplished by means of the job tags on the particular parts involved and depends primarily on their relative priority as determined by the scheduled completion date of the machine to which they belong. No formal scheduling procedures utilizing individual operation processing times and machine load charts are in use, though apparently Gantt type charts for displaying scheduling and control data have been employed sporadically in the past. In lieu of a tightly controlled scheduling and dispatching system wherein the job tag of the part itself would constitute authority for sequential processing, a highly flexible procedure is employed to schedule thru the machine shop on a day-to-day basis. This procedure entails utilization of a daily conference of the production scheduling group, consisting of the Shop Superintendent and his foremen, which occurs at the end of each working day and has as its objective the scheduling of work for the following day. At this time the Shop Superintendent with the foremen compares and evaluates the progress of open job orders with their promised dates of completion, discusses existing difficulties, and the momentary availability of necessary materials. Depending on the possible changing of priorities, they schedule and release designated parts job-tagged to particular orders for sequential movement through production. While this type of scheduling does utilize the collective knowledge and experience of the group in informally estimating and allowing for processing times, designating methods and procedures of operations, and undoubtedly gives the departmental foremen a healthy overall picture of why priorities must be changed within their departments, one weakness appears to lie at the level of actual dispatching work to the machines.

6.2.3 Dispatching. All items job-tagged for processing are banked on tables adjacent to the machine shop areas as they arrive from disassembly, and move from this point on to the machines as personally designated by the foreman, in a priority determined from the previous day's scheduling. This tends to require individual machine operators to draw job-tagged parts individually from the foreman, requires an inordinate amount of the foreman's time to be spent in the immediate vicinity of this bank of parts, and can result in idle manpower while operators wait for assignment of tasks. Proper machine utilization is made additionally difficult, in that parts move from the bank to the machines with predominant emphasis on constantly changing priorities alone, and with insufficient regard to the type of machines available or the set-up time that may be required.

As the parts are processed each machine operator enters on the job tag the time he spends on the particular item, and these times are accumulated as the parts proceed through the scheduled operations back to the assembly area. At the assembly area the job tags are removed from the part and are returned to the write-up desk where they are temporarily filed by job order number.

6.2.4 Controls. Continuous follow-up control is accomplished through the Shop Superintendent's daily scheduling conference where tentative schedules are checked against promised completion dates. As the completed job tags are collected at the write-up desk, the corresponding line items of the working copy of the Production List are noted to indicate completion. This information is transferred daily to the original control copy in the Production Office, where final progress of the individual orders is evaluated, and necessary expediting action initiated. Here, the master file of job orders is maintained up to date to reflect the current status of all job orders in process. A Master Control Sheet is utilized to summarize the state of completion of jobs and to accumulate direct labor charges as obtained from the job-order tags.

6.2.5 Reports. No written formal production reports exist as such. Summaries of production statistics by individual job orders, and reports concerning the division as a whole, are made to management as desired or required.

6.2.6 Resale Equipment. Machine tool equipment purchased by the Simmons Machine Tool Corporation for speculative resale entails little deviation from the normal production control procedures described above. Machine tools acquired for this purpose are usually retained intact in their existing condition until sold. Upon purchase by a customer, reworking or modernization, if desired, is provided for in the same manner as machines received for rebuilding and return.

6.2.7 "SKY-PARK". In addition to machine tool repair and rebuilding as described above, the Machine Tool Division manufactures the Simmons "SKY-PARK" machine in response to firm orders from customers. Presently, the "SKY-PARK" volume of operations constitutes only a small portion of the overall business of the Machine Tool Division. Individual orders to fill customer demand are informally scheduled as received.

6.2.8 Discussion. Overall, formalized planning and control in the Machine Tool Division is conspicuous by its absence. Although initial job planning is accomplished and manpower and shop equipment availabilities are known, no attempt is made to translate this information into a formal schedule. Without this information in the consolidated format that a schedule provides, the Shop Superintendent does not have a complete picture of the status of work for periods much longer than one day. Consequently, when confronted with demands for frequent changes in priorities, he is unable to adequately advise top management of the effects such changes will have on work already in the system.

Frequent changes in work priorities force shop supervision to make continuous day-by-day adjustments in their informal planning, with the result that coordination of work becomes extremely difficult and men and equipment are not utilized most profitably. Shop supervision finds itself performing what might otherwise be routine planning, scheduling, and material expediting functions on a "put-out-the-fire" basis with only limited time available for their most important function of supervising the working force.

It is not intended to imply that an elaborate, formalized system of production planning and control would be the solution to existing problems. Obviously, current work load and the availability of men and equipment does not warrant such detail. But careful analysis, on the part

of management, of accepted planning and control procedures should readily disclose which methods and what degree of formality are best suited for the Division. For example, by translating the initial job planning information, which becomes available when the job is written up, into a bi-monthly or monthly work center schedule, shop supervision would have a basic tool for control. These very general schedules, if the Gantt type chart is employed, could be kept current by the write-up man or a clerk in the Production Office. They would provide the basic information necessary to keep top management advised of shop progress and the effect changes in priorities might have on current work. The schedules would also provide foremen with the information they need to effectively dispatch work to their crews.

6.2.9 Recommendations. It is recommended that:

1. The historical information utilized by shop personnel to estimate jobs be formalized and used as a basis for rough scheduling by work centers.

2. The write-up man in the Production Office be assigned the additional duty of maintaining up-to-date work center schedules.

3. Shop supervisors, once work center schedules are established, be freed from routine, day-by-day scheduling duties and concentrate on their primary function of supervising the work force.

4. Consideration be given to developing only the minimum necessary production reports to be utilized by supervision for control purposes and by top management as production status information.

5. Every effort be made by top management to limit changes in priority assignments so that men and facilities of the shop may be utilized more economically.

6.3 Fastener Division.

6.3.1 Planning and Work Authorization. The manufacturing authorization for Simmons Fastener Division consists of either individual and/or blanket orders from various customers for both plastic SPRING-LOCKS and metal fasteners. At the time the customer considers placing an order and re-

quests price data, an estimate of his annual requirement is given to permit the Fastener Division to determine tooling required. At the same time Thermo Products, Inc., an independent concern that performs the plastic molding operation, is furnished drawings of all production parts and copies of orders for tools (molds) to be used. Tools for the plastic molding are supplied by the customer and are loaned to Thermo Products, Incorporated, for their use and upkeep. Customer's individual orders are primarily applicable to sale of metal fasteners, while the high volume plastic fastener business is more often characterized by receipt of a customer's blanket order, subsequent releases to production, schedules and periodic re-schedules. Receipt of releases increasing or decreasing requirements, and re-scheduling, usually cover a four to six-week period projected ahead one month and are revised monthly.

These customer orders are converted to a "Simmons Machine Tool Corporation Sales Order" (Figure 3-4) multiform, and copies thereof are distributed as necessary within and without the Fastener Division (Figures 4-5 and 4-7) to initiate the manufacturing process and to control and follow up production through to the ultimate shipping of the product.

6.3.2 General Scheduling. Programming and general production scheduling commence with receipt of the customer's requirements and specified delivery dates. This information is entered on a Record of Shipments and Back Order Control form and a Customer Shipping Schedule form which are attached to a working copy of the Sales Order and which will remain active papers until the order is completely filled, at which time they are filed by customer in the completed order file. Simultaneously, information is recorded on a Record Control Card to show not only quantities ordered, shipped, and remaining due customer, but also status of requirements and receipts due from Thermo Products, Incorporated, as pertains to the particular order. The release for production, in the case of metal fasteners, consists of the distribution of the manufacturing copy of the Sales Order to the plant floor via the Plant Superintendent for detailed scheduling, and as applies to the plastic fastener, consists of a Vendors Shipping Schedule, Figure 6-2, being sent to Thermo Products, Incorporated, as their authorization for the molding of the parts around the inserts. Subsequent re-schedules and quantity changes are issued to Thermo Products, Incorporated, on the same form, but indicate that they supersede the referenced previous schedules. The metal insert schedule of production is

issued bi-monthly to the Plant Superintendent by means of the Insert Status Report and consists essentially of the balance required for each of the nine basic types of standard metal inserts. This schedule is developed from demand forecast, based on actual insert usage over a period of the last twelve weeks and is projected ahead a like period. Accompanying this report is a Plastic Component Parts and Wire Status Report form which details the requirements on hand, amount due from vendors and delivery dates, and the raw material and components going into the various type plastic fasteners currently on order by customers. While these projected requirements are extended in time they can readily be curtailed in view of their re-determination every two weeks. The insert schedule of production takes into consideration a known wastage of inserts of approximately fourteen per cent (14%). It is to be noted that this wastage by Thermo Products, Incorporated, is recognized and accepted, and inserts are furnished to them for molding into the finished fasteners at this ratio. This loss is sustained by the Fastener Division.

6.3.3 Dispatching. No detailed scheduling on the plant floor utilizing men or machine load charts is employed. The plant superintendent schedules production of the various types of metal inserts by means of the bi-monthly insert schedule, and production of the metal fasteners from the manufacturing copy of the standard Sales Order form. He processes the necessary vendor-supplied parts, and manufactures the remaining parts not already present in in-process inventory to meet the requirements for the particular type of metal fastener. Production of the needed parts is scheduled in economic lot size, but this is apparently based solely on the experience of the Plant Superintendent, and probably takes into consideration his forecast demand for parts at a later date over and above this particular order.

6.3.4 Work Sampling. Since it was considered that actual manpower and machine utilization might further point up the deficiencies resulting from this lack of planned workload scheduling, a conventional sampling study was made.

All potentially productive machinery in the Fastener Division was first determined and identified by general type. Sampling sheets were prepared listing these machines, a total of 91 separate pieces of equipment, and 48 individual production workers. Activity was recorded on

the sampling sheet under one of the following categories: producing; watching machine; non-productive work; personal and/or inactive (for personal) and producing attended; producing unattended; maintenance/set-up/adjust; idle (for machines). A total of 5444 observations were made during the period of the study, and results are shown in tabular form on Figures 6-3 and 6-4.

The total machine utilization observed during the above period was 12.8% Producing Attended and 8.7% Producing Unattended, or 21.5% total productive during the 3,640 machine utilization observations made. The standard deviation was 0.22%. At the 95% confidence level, the determination of productive utilization is accurate within ±0.44% for the period of observation.

The study for overall operator productivity showed that 39.9% of the time was spent productively and 16.0% of the time was spent watching the machines in the 1804 observations. The productive time, 39.9% is within ±2.4% and the watching machine time is within ±0.6% at the 95% confidence level.

Inasmuch as it was not feasible to obtain the actual cost data required for a complete analysis, Figures 6-5 and 6-6 have been shown in relative dollar values to emphasize the cost of non-productive activity. Figure 6-5 expresses the results of the machine utilization study in terms of machinery depreciation and maintenance expenses. Figure 6-6 displays the results of the manpower utilization study in terms of direct labor dollars.

Results of this study would appear to indicate, at least tentatively, that more detailed attention to scheduling problems could result in sizeable overall savings to the company.

6.3.5 Controls. Follow-up on all orders is maintained by perusal of the active working copy of the Sales Order with the Record of Shipments and Back Order Control form and the Customer Shipping Schedule form as well as by means of the Record Control Cards maintained in the Production Manager's office. A daily report is prepared by an assistant Plant Superintendent showing particular items being run on individual machines to permit continued appraisal of production progress. A daily report of Thermo Products, Incorporated operations, showing machine utilization by cavities per mold and by fastener type part, is made to the Production

Manager to provide confirmation that molding operations are proceeding as required. Accompanying this report is a sample consisting of one run of each mold then in use. Thermo Products Incorporated also submits a semi-monthly Plastic Powder Inventory and Powder Requirements report which not only appraises the Production Manager of its ability to meet requirements for delivery of the plastic fasteners, but also appraises him of molding powder on hand or on order that is not scheduled for use and which might constitute a financial liability to the Fastener Division.

6.3.6 Recommendations. It is recommended that:

1. The Production Manager be provided with an adequate staff of personnel to permit the discharge of normal production planning and control functions.

2. Concerted effort be made to schedule fastener orders, in economic lot sizes, not only through the shop but through the outside operations of plating and plastics.

3. The Sales Order (for metal fasteners) and the Vendors Shipping Schedule (for plastic fasteners) be considered as firm production orders which cannot be varied with respect to quantity without issuance, by the Production office, of written change order.

Nº 10858

Sheet No._____

PRODUCTION LIST

Item No._____ Date Listed _____

Description_____ Foreman_____ Mechanic_____

Part No.	Qn.	Description	To Be Made By	Remarks

FIGURE 6-1

SIMMONS MACHINE TOOL CORP.
SIMMONS FASTENER CORPORATION

ALBANY 1, N. Y.

VENDOR SHIPPING SCHEDULE

SUPERSEDES SCHEDULE DATED_____

TO

DATE

ORDER NO.	PART NO.	DESCRIPTION AND REMARKS

AUTHORIZATION OR REFERENCE	LAST DELIVERY CONSIDERED			INCREASE OR DECREASE	TOTAL BALANCE DUE	SHIPPING INSTRUCTIONS
	DATE	INVOICE	QUANTITY			

SPECIAL INSTRUCTIONS

SIGNED _____

FIGURE 6-2

SUMMARY OF WORK SAMPLING DATA, MACHINE UTILIZATION

	Producing Attended		Producing Unattend.		Maintenance Setup & Adj		Idle		Total
	No.	%	No.	%	No.	%	No.	%	No.
Punch Press, Large	33	16.5%	0	0	13	6.5%	154	77%	200
Punch Press, Medium	9	4.5%	1	.5%	15	7.5%	175	87.5%	200
Punch Press, Insert	0	0	240	60%	19	4.7%	141	35.3	400
Punch Press, Light	50	7.8%	0	0	26	4.0%	564	88.2%	640
Turntable Assby. Press	66	55.0%	0	0	7	5.8%	47	39.2%	120
Impact Rivet Press	0	0	0	0	0	0	40	100%	40
Spin Rivet Press	4	5.0%	0	0	0	0	76	95.0%	80
Foot Press	59	21.1%	0	0	0	0	221	78.9%	280
Foot Shear Press	0	0	0	0	0	0	40	100%	40
Hand Box Break	0	0	0	0	0	0	40	100%	40
Bench Miller	3	3.8%	0	0	0	0	77	96.2%	80
Production Drill Press	16	20.0%	0	0	2	2.5%	62	77.5%	80
Horizontal 2-Sp Drill	84	26.2%	0	0	6	1.8%	230	72.0%	320
Turntable Slot Miller	13	16.2%	0	0	2	2.5%	65	81.3%	80
Power Lacer	0	0	0	0	0	0	80	100%	80

Figure 6-3

	Producing Attended		Producing Unattend.		Maintenance Setup & Adj		Idle		Total
	No.	%	No.	%	No.	%	No.	%	No.
Hand Lacer	40	16.7%	0	0	1	.4%	199	82.9%	240
Serrating Machine	0	0	0	0	0	0	40	100%	40
Wire Straightener	49	40.8%	0	0	8	6.7%	63	52.5%	120
Gas Weld	0	0	0	0	0	0	40	100%	40
Arc Weld	1	2.5%	0	0	0	0	39	97.5%	40
Spot Weld	7	8.7	0	0	1	1.3%	72	90.0%	80
Tumbler	0	0	74	46.3%	3	1.8%	83	51.9%	83
Wash & Degrease	4	5.0%	2	2.5%	0	0	74	92.5%	80
Prod. Turret Lathe	11	13.8%	0	0	4	5.0%	65	81.2%	80
Production Do All	1	2.5%	0	0	2	5.0%	37	92.5%	40
Flaring Turntable	6	15.0%	0	0	2	5.0%	32	80.0%	40
Totals	456	12.8%	317	8.7%	111	3.0%	2756	75.5%	3640

Figure 6-3
(Cont'd.)

SUMMARY OF WORK SAMPLING DATA, MANPOWER UTILIZATION

	Number of Observations	Percentage
Producing	718	39.9%
Watching Machine	290	16.0%
Non-Productive Work	294	16.3%
Personal &/or Inactive	502	27.8%
TOTALS	1804	100.0%

Figure 6-4

MACHINERY UTILIZATION IN TERMS OF RELATIVE MACHINERY DEPRECIATION AND MAINTAINENCE EXPENSES (PER DOLLAR OF COST)

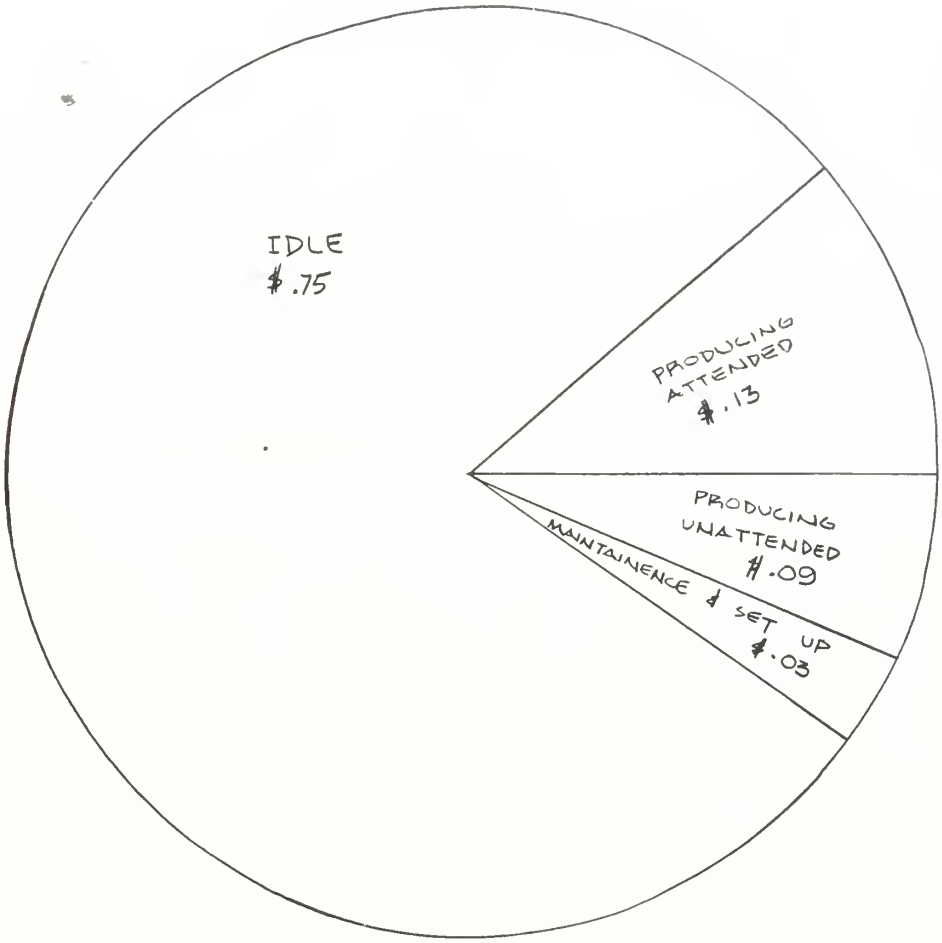


FIGURE 6-5

MANPOWER UTILIZATION IN TERMS OF RELATIVE DIRECT LABOR DOLLAR

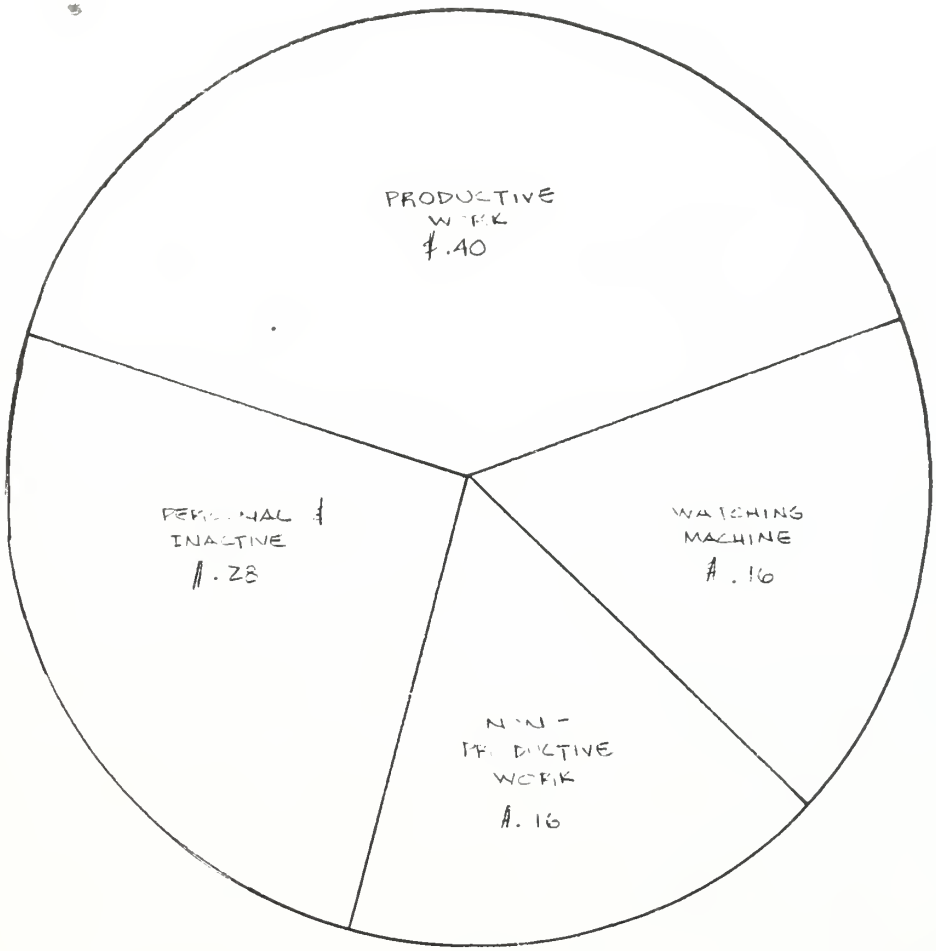


FIGURE 6-6

CHAPTER 7 - MATERIAL AND QUALITY CONTROL

7.1 Material Control.

7.1.1 General. An efficient material control system is essential to good production planning and control. Timely procurement of materials necessary for the manufacturing process helps to insure that production schedules will be met without delay. But it is not sufficient to merely provide sizeable stocks to insure against anticipated or possible needs. Material in stock can represent a sizeable investment, not only in direct material costs, but also in such indirect costs as storage and handling charges, possible deterioration expenses, and losses resulting from a depression of the market. Thus, an effective material control system must provide a suitable balance between the cost of maintaining the inventory and the intangible costs resulting from not having material on hand when needed.

7.1.2 Machine Tool Division. For the purposes of this study, material in the Machine Tool Division was grouped into the categories of (a) low cost expendibles and standard repair parts, (b) medium and high cost repair parts, components and subassemblies, (c) used parts and scrap, and (d) machine tools. These categories will be discussed separately since different degrees of control should exist for each.

Low Cost Expenditures and Standard Repair Parts. A limited but highly variable stock of expendibles (nuts, bolts, etc.) is stored in the shop tool crib from where it is issued as long as the supply exists. Re-orders are placed at the time existing stock is exhausted. At the present time, expendibles appear to be overstocked, no accurate inventory exists, and no plans for orderly replenishment based upon usage data were discovered. No consideration appears to be given to stocking standard repair parts. Furthermore, issuing these frequently-used, low-cost items from thetool crib would appear to place unnecessary controls on this category of material.

Medium and High Cost Repair Parts, Components and Sub-assemblies. At the present time, no provision exists for stocking material in this category, although these items have been stocked in the past. Parts, components and sub-assemblies such as bearings, gears, motors,

electrical control assemblies and "SKY-PARK" materials are ordered only when an actual need for a specific job is determined. No noticeable delays in procurement were discovered. Since these items can represent a sizeable investment, and since such parts are rarely interchangeable between machine tools, the present policy of not stocking material in this category is considered to be an intelligent one. Furthermore, such parts are usually delivered directly to the work center performing the work, thus eliminating the need for the stringent controls which would be appropriate for these more expensive items.

Used Parts and Scrap. A fairly large stock of used parts and scrap removed from machine tools being overhauled or modernized has been accumulated in open storage, generally segregated by type. Scrap is stored in stock racks. This material may be used as replacement parts or, more typically, may be used as basic stock from which similar parts are machined. Obviously, the reuse of these parts is cost saving; and this policy should be continued. Shop personnel would be materially assisted, however, if these parts were administered by a material clerk. Since these parts can represent a moderate investment, limited controls of their use appears warranted.

Machine Tools. The Machine Tool Division has a considerable investment in machine tools purchased on a speculative basis or on a known requirement of a customer. An adequate inventory of this equipment is maintained, and sufficient controls over these machines appears to exist. Since top management is directly concerned with this stock, value of equipment on hand is constantly under surveillance.

7.1.3 Fastener Division. Material in the Fastener Division has been divided, for purposes of analysis, into (a) raw materials and purchased parts, (b) work-in-process including component parts, and (c) finished goods. Each of these categories will be discussed separately, but since there are certain general material control principles which are applicable to all classes, a summary discussion will be included after specific categories are analyzed.

Raw Materials and Purchased Parts. Responsibility for initiating procurement request action for raw materials and purchased parts is vested in the Production Control Department. Order quantities are determined by forecasting

future demand and analyzing past usage data. Procurement source and cost information is also determined by the Production Control Department and included on the purchase requisition before it is forwarded to the Purchase Division of the Machine Tool Corporation for final procurement action. Order Cards as shown in Figure 7-1 are used by the Production Control Department to maintain records of outstanding orders with appropriate entries made to record the dates requisitions are initiated, dates copies of purchase orders are received from the Purchase Division, receipt dates, etc. No pre-determined raw materials inventory stock levels and no maximum or minimum stock levels by type of material are established. Apparently, it is the Division's policy to have a sufficient amount of raw materials and purchased parts on hand to meet any expected requirement. Determination of order quantity is based, in varying degrees, upon the cost of materials being purchased, the availability of storage space, and the usage rate of this material. Obviously, the Production Control Department is not in a position to make a more comprehensive analysis. The Purchase Department of the Machine Tool Corporation, which is established to provide centralized procurement services, should perform systematic analyses to determine economic order quantities and appropriate inventory levels based upon turn-over rates. It would seem, in addition, more appropriate if the Purchase Department determined the source and price of materials being ordered.

When raw materials or purchased parts are received, receiving reports are prepared and quantities received are posted on the Raw Material Inventory Card as shown in Figure 7-2. This card is intended for use as a perpetual inventory record by type of material. Raw materials are stored throughout the Fastener Division wherever space is available. When they are withdrawn for use, a Movement of Material Form, Figure 7-3, supposedly is prepared to indicate that this material has been transferred to another inventory account. Based upon these Movement of Material Forms, adjustments are recorded on the Raw Material Inventory Card. The lack of control over storage of materials makes it virtually impossible to maintain an accurate perpetual inventory or to control receipts and issues. Raw materials and purchased parts, although they can represent a sizeable investment, are generally readily available for indescriminate use, mis-appropriation, misuse and damage due to improper and excessive handling. Raw material balances are determined annually by actual physical inventory. Records studied, however, indicated that unfavorable variances frequently exist. This further

points up the need for adequate controls. Consequently, consideration has been given, in Chapter 9 to providing physical facilities to alleviate this problem.

Work-in-Process and Component Parts. When raw material is required for processing, it is removed from the raw material inventory and transferred to Work-in-Process with appropriate entries being made on the Work-in-Process inventory card similar to Figure 7-2. All raw material so transferred remains in work-in-process, regardless of whether it is actually being processed or not or the degree of completion, until transferred to finished goods inventory. Thus this category can include a sizeable stock of component parts (i.e., blades, anchor plates, keeper plates, etc.). Unfortunately, although these component parts are frequently interchangeable within basic fastener types, adequate information is not available on their status to assist the Division in meeting shipping dates. Work-in-Process is stored indiscriminately throughout the work area whenever space is available. Little segregation is attempted and the material is rarely identified by tagging of the storage containers. Also included in this category are materials transferred out of the area for additional processing such as plating and plastic molding by private enterprises.

There is no possible way for management to determine the status of work-in-process except through actual physical inspection. The lack of records of any component parts inventory appears to be a critical fault of the material control system in effect. Employees have considerable difficulty in locating desired materials, and, without even basic inventory data, procurement of raw materials and inventory evaluation are unduly complicated. It would appear that proper records and adequate storage facilities could measurably improve this situation.

Finished Goods. Finished goods inventory records are maintained on a Finished Goods Inventory Card similar to Figure 7-2. The Movement of Material Form, previously referred to, is used to inform the Material Control Section of the transfer of this work from the work-in-process category. Since finished goods inventory balances rarely coincide with physical inventory counts, it would appear that work-in-process is not being systematically transferred to finished goods. Spot checks indicated that the actual finished goods inventory is larger than stock records would indicate. As a result, production planning is seriously handicapped and over-production is not uncommon.

Finished goods are placed in one general area, but facilities are not available to permit adequate segregation by type of item. Excessive handling is required to locate and ship orders. No stock levels have been established locally, but it would appear that a two-week supply of some plastic fasteners is on hand. On-hand quantities of finished metal fasteners is limited to those fasteners which were in excess of a specific customer order. This would refute advertising literature which implies that standard types of fasteners are available for immediate shipment from local stock. As in the previous category of material, lack of controls would appear to be the major problem.

Summary. Although the Fastener Division has a basic inventory control system, it is not functioning properly. No methods exist to:

A. Determine the actual requirement of any inventory.

B. Determine when to reorder.

C. Control the receiving, storage and issue of material from the inventories.

D. Determine the actual status of the inventories.

E. Ensure the security of the inventories.

F. Physically control the material that makes up the inventories.

G. Determine summary information on inventory position for control purposes.

H. Assign responsibilities for the inventories.

I. Assign authority to control adequately the inventories.

J. Establish adequate handling procedures.

No formalized inventory planning exists and what inventory records that are available are not kept current. These problems can be attributed to a lack of responsibility definition. Until management assigns full

responsibility for material control to a competent individual and provides adequate facilities for receipt, storage, issue and control of materials, little improvement can be expected.

7.1.4 Recommendations. Recommendations contained herein for the Fastener Division presuppose that the suggestions for establishing adequate material storage facilities and office spaces and for providing material handling equipment which are contained in Chapter 9 are adopted. It is recommended that:

1. Consideration be given to establishing planned stocks of low cost expendibles and standard repair parts with controlled maximum and minimum limits and realistic reorder levels in the Machine Tool Division.

2. Low cost expendibles be de-controlled to the extent that frequently used items are placed in "pre-expended" bins readily accessible to the work areas in the Machine Tool Division.

3. Used parts and scrap be placed under limited control by assigning responsibility for their inventory, custody, and issue to a stock clerk in the Machine Tool Division.

4. Full responsibility for material control, including receipt, custody, issue and record keeping be assigned to the material control section of the Production Control Department, Fastener Division, and that acceptable procedures be defined.

5. Sufficient personnel be made available to this section of the Fastener Division to carry out properly the material function.

6. The Purchasing Department of the Machine Tool Corporation be given responsibility for developing all cost and source information for procurement.

7. The Purchasing Department investigate the present order quantities for all materials purchased for the Fastener Division and determine economic order sizes.

8. Consideration be given to the establishment of maximum and minimum stock levels and appropriate reorder points for raw materials, components and finished goods in the Fastener Division.

9. A simplified system be adopted to permit accounting for component parts inventory in the Fastener Division.

10. All material which is not actually being worked on be stored in the designated storage area under the custody of the material clerk, Fastener Division.

11. When material is sent by the Fastener Division to a vendor for specialized processing, it be carried in a separate work-in-process inventory.

7.2 Quality Control.

7.2.1 General. Quality Control to some degree is an essential requirement of any manufacturing process. A proper balance, however, must be maintained between the cost of operating the quality control program and the gains resulting by reduction in manufacturing costs and increases in customer good will. This concept will be the basis upon which the analysis of the quality control procedures in the Machine Tool and Fastener Divisions is based.

7.2.2 Machine Tool Division. If a customer purchases a machine on an "as is" basis, no inspections are performed by the Machine Tool Division prior to shipment. Usually, however, customers desire a certain amount of overhauling or rebuilding of machines purchased so the same procedure is followed as with customers who send their machines to Simmons to be over-hauled and returned. Where applicable, the following inspections are made:

A. Pre-disassembly Inspection. When machines are to be rebuilt or modified, they are operated and inspected prior to disassembly. This operational test permits the mechanic to evaluate the machine and provides information as to the areas requiring attention.

B. Parts Inspection. After disassembly and cleaning, mechanics inspect the individual parts and decide which units require attention. These parts are then reworked or replaced. Prior to reassembly all parts are inspected by the foreman for proper dimensions and quality.

"SKY-PARK": Inspection of Purchased Materials. The Receiving Department of the Machine Tool Division checks the incoming raw materials, electric motors, hydraulic pumps and other component parts to insure compliance with specifications.

"SKY-PARK": Assembly Inspection. During the manufacture of parts and assembly of the "SKY-PARK" machines the foremen periodically inspect the various components for proper fit and quality of work. After the machines are completely assembled they are given an operational test. This test is performed by placing four tons of I-beams on each platform and raising and lowering the unit several times to check for proper operation and strength. When the machines have passed this test, they are ready for disassembly and shipment.

Discussion. Quality control is basically the responsibility of shop supervision. All foremen appear to be aware of the responsibility for maintaining high standards of quality in their respective areas. Due to the job shop type of operations performed, the present means employed for maintaining the quality level is considered to be appropriate and satisfactory.

7.2.3 Fastener Division. For purposes of investigating the quality control techniques utilized by the Fastener Division each of the two major products, plastic and metal fasteners, is treated independently.

Plastic Fasteners:

A. Raw Material Inspection. The first inspection performed in the production of the metal inserts for the Plastic Fasteners is performed by the Plant Superintendent or his representative. This inspection verifies that the material is the type desired, and consists of checking the material to ensure conformance with specification.

B. Machine Set-up Inspection. The next inspection is performed by the mechanic who sets-up the metal insert machine. After he sets-up the machine and makes the necessary adjustments the machine is operated for a short trial run. The inserts produced from this run are inspected by the mechanic for shape and wire length by the use of a micrometer gauge. This adjustment and trial run procedure is continued until the mechanic is satisfied with the dimensions of the sample inserts produced. The

machine is then turned over to the assigned machine operator so that she may commence production.

C. Operator Inspection. The machine operator remains in the vicinity of the machine while it is in operation. In addition to keeping the wire oiled, her duties include observing the operation of the machine to assure that the wire is feeding properly and completed inserts are falling into the catch pan. When the catch pan is filled, the operator stops the machine and randomly inspects a handful of inserts with a metal gauge. If the inserts fit the gauge properly, the load in the catch pan is dumped into a large tote pan. If the inserts do not fit, the load in the catch pan is scrapped and a mechanic is called to adjust the machine. Large runs of defective inserts are thus prevented.

D. Plating Inspection. Metal inserts are sent to a private concern for plating to prevent their corrosion before and after the plastic is molded around them, as corrosion causes the plastic to crack and become loose. Plating also prevents any toxic chemical reactions from occurring when the completed fasteners are used in refrigerators. When the plated inserts are returned to the Fastener Division, they are inspected 100 per cent. This inspection is a visual inspection performed for the following reasons.

1. To insure that the inserts are completely and properly plated.

2. To separate the defectively-shaped inserts from the lot.

3. To untangle the inserts so that they may be readily handled during plastic processing.

E. Final Inspection. After the above inspection is completed the inserts are sent to Thermo Products, Incorporated, where the plastic is molded around the insert to form the completed fastener. At Thermo Products, Incorporated, the plastic molding operators place the inserts in the molding cavities manually, and defective inserts remaining in the lot are usually detected at this time. After the molding operation is completed, the gates and sprues are trimmed off. The molding operators and trimmers visually check the fasteners for proper molding and positioning of the inserts within the plastic as the operations are performed.

The completed shelf supports are then packed and sent back to Simmons Fastener Division for shipping.

Metal Fasteners. Quality control for metal fasteners is accomplished through random inspections of the various parts and assemblies which indicate when machine adjustments become necessary. Since there are so many types and variations of metal fasteners, only general procedures will be discussed.

A. Raw Material Inspection. All raw material is inspected for conformance with the specifications by the Plant Superintendent or his representative.

B. Purchased Parts Inspection. Parts for metal fasteners received from vendors are given 100 per cent inspection on a gauge. Units not passing inspection are separated and scrapped. Percentage of defectives or variance from prescribed tolerance is not recorded.

C. Set-up Inspection. When machines must be set-up for special type of work such as stamping, an authorized mechanic performs this operation and makes a few pieces. These pieces are checked, and adjustments are made as required until the machine is properly set.

D. Operator Inspection. The regular machine operator periodically stops the machine and inspects a few units. If the units are out of tolerance, the defectives are scrapped and the mechanic readjusts the machine. Additional random inspections are made of completed units in the large tote pans.

E. Assembly Inspection. During the assembly process individual components are visually inspected. Defective items are scrapped and no record is made or sample retained to indicate the type or cause of defects.

F. Final Inspection. Prior to packaging for shipment all fasteners are given a 100 per cent inspection for tolerance and operation.

Discussion. Inspection procedures appear to detect sufficient defectives in each lot to maintain the desired level of quality. Due to the size of present operations, an elaborate quality control program is not considered necessary. There are a few aspects of the present system, however, which could be improved. Since metal inserts are randomly checked for size and shape during production by machine operators and again by the plastic molding machine operators, 100 per cent inspection upon return from plating appears excessive. However, in view of the importance of the plating operation, an inspection of some type upon their return is required. It is believed that statistical sampling techniques are applicable.

The cursory nature of the present 100 per cent inspection cannot possibly guarantee the removal of all defectives. Controlled studies in similar manufacturing processes have shown that four consecutive 100 per cent inspections still failed to eliminate all defectives.

As noted earlier, some of the parts received from vendors are given 100 per cent inspection prior to use. Sampling techniques applied at this time may be more appropriate. Vendors should be notified of acceptance levels if sampling techniques are used.

The other inspections performed during the processing of the metal fasteners do not appear to be excessive. It is to be noted, however, that a simple follow-up system could be devised to point out faulty machines and identify careless operators.

It is interesting to note that there is no quality control department in existence in the Fastener Division. In spite of this lack of designated responsibility, quality appears to be excellent. Although there is no record of customers dissatisfied by reason of poor quality, the importance of maintaining high quality would indicate that responsibility for quality control should be assigned to the Production Department.

7.2.4 Recommendations. It is recommended that:

1. Statistical sampling techniques be investigated for the Fastener Division to determine their application.

2. A simple follow-up plan to investigate causes of major defective items be designed for the Fastener Division.

3. Responsibility for Quality Control in the Fastener Division be assigned to the Production Department.

DESCRIPTION

MAX.

MIN

SIZE

VENDORS

1.

2.

3.

4

YR.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV	DEC	TOTAL

REQUISITION					PURCHASE ORDER				
DATE	QUAN.	PRICE	REQ. DATE	APPROVAL	DATE	VEN	ORDER NO.	PROM. DATE	REMARKS

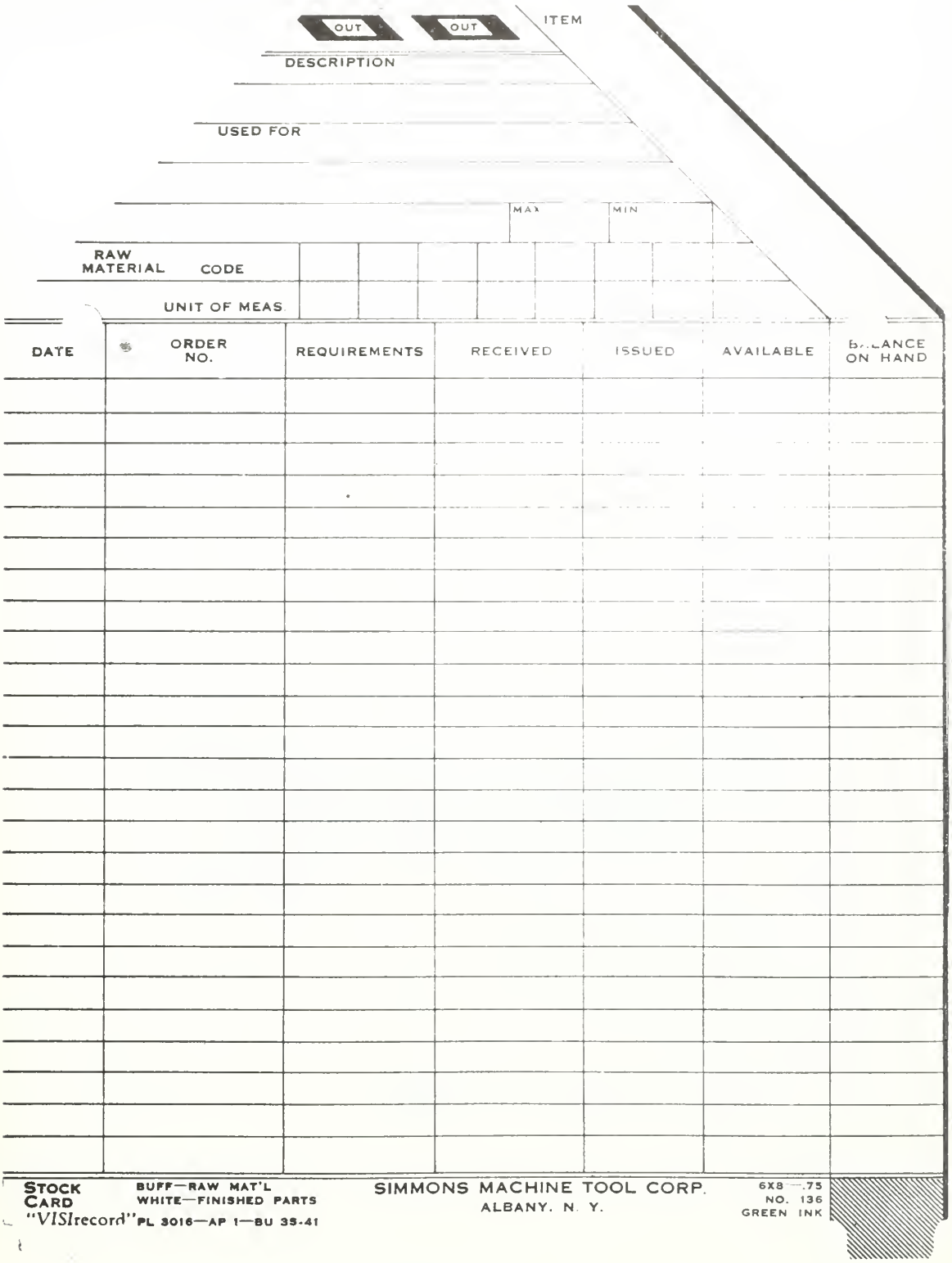
ORDER CARD
"VISIrecord" PL 3017—AP 1—BU 35-41

SIMMONS MACHINE TOOL CO.
ALBANY, N. Y.

6X6.5—.75
NO. 228—BUFF
GREEN INK

ORDER CARD

FIGURE 7-1



RAW MATERIAL INVENTORY CARD

FIGURE 7-2

DATE _____

MOVEMENT OF MATERIAL FORM

DESCRIPTION OF MATERIAL _____

FROM: AMT.

BLANK STOCK _____

IN PROCESS _____

COMPLETED STOCK _____

TO: AMT.

IN PROCESS _____

COMPLETED STOCK _____

COMPONENT PARTS USED WITH ABOVE

DESCRIPTION	AMT.
_____	_____
_____	_____
_____	_____

SIGNED _____

FIGURE 7-3

CHAPTER 8 - METHODS AND STANDARDS

8.1 Introduction. Methods and standards have been considered for purposes of this report, to be limited to incremental work operations. This is opposed to the analysis of overall process operations for specific parts which are included in Chapter 9 under Process Flow. Particular attention has been directed to those individual methods which are considered to be typical or representative. Since standards are essential to the Production Planning and Control recommendations contained in Chapter 6, particular emphasis has been devoted to this subject.

8.2 Machine Tool Division. There are no formal methods and standards existing in the Machine Tool Division. It is realized that the nature of the operations is in the large part intermittent; however, the type of operations performed are repetitive in the sense that they are done in some form on every machine that is rebuilt. Work scheduling is being handled at the present level of operations by the experience and cooperation of the various supervisors in the shop. Even under these conditions a certain portion of the work is performed on a "put out the fire" basis in order to meet priorities and dead lines. As a substitute for formal standards, the supervisors rely on their own experience and their knowledge of the workers' capabilities to establish the "yard-stick" upon which to measure the output of the worker and schedule the jobs through the shop. To make this system work, a large portion of the supervisors' time is devoted to setting up a tentative schedule, checking to see if this schedule is being carried out and revising this schedule as necessary to meet the deadlines on the priority jobs. It is visualized that a system of predetermined time standards could be adapted to this type of operation. These standards could be refined as necessary to keep them in line with what can realistically be expected from the shop. It would then be possible to schedule the shop work in the manner suggested in the production planning and control section of this report (Chapter 6).

In contrast with the varied characteristic of the work associated with the rebuilding of machine tools, the manufacture of the "SKY-PARK" machine uses parts produced

on a repetitive basis steming from an established process flow as set forth in Chapter 9. This operation is not continuous but is set up in response to firm orders from customers. The fact that this operation is not a continuous one lends support to the contention that standards are essential if this operation is to be scheduled into and out of the shop in an expeditious manner. Work standards should therefore be established for the various operations so that time schedules and the allocation of production space discussed in Chapter 9 might be made on a realistic basis and with the least interference with the other operations in the machine shop.

The establishment of these standards is essential to the proper implementation of the standard costing system suggested in Chapter 4.

8.3 Fastener Division.

8.3.1 Methods. Methods design, analysis, or improvement are not provided for as specific functions or activities in the Fastener Division organization. Two persons within the organization carry an implied responsibility for Methods Design and Improvement. The Director of Product Design and Development formulates original methods designs, while methods improvement is considered part of the Plant Superintendent's responsibility for overall production.

Present System of Methods Design and Improvement. As the Designer develops a product, he makes a mental formulation of the process and methods by which it is to be manufactured. There is no clear division between product design and methods design as the prototype usually is constructed by the Director of Design and Development personally. For clarity, the typical production development sequence is described. Most products start out with a small experimental or trial order. The desired product is designed, and at the same time a mental formulation of the methods and sequence of operation to be utilized in the manufacture is made. The necessary machines are set up for a limited run. Operations at this stage will, at best, be manually controlled.

Should the initial run prove successful and additional orders be received, the production methods are considered by the Plant Superintendent. Where the original methods are considered reasonable, they are retained for production until something renders the need for improvement

obvious. When the situation is such that problems involving quantity, required delivery rate, or costs can be foreseen, methods improvements are initiated before production is begun. In those cases where improvement is apparently needed, the Plant Superintendent starts the action. He may try a method similar to one being utilized on another job; he may ask the machine shop to make a special tool; or, where the method is complicated, he will ask the assistance of the Director of Design and Development. In the latter cases, the Director of Design and Development will design the improved method. In designing methods improvement, involving significant changes in tooling, the costs of the change and the expected production rates with the proposed method are estimated by the Director of Design and Development.

Records. Methods utilized in the Fastener Division are not recorded.

Analysis of Present Methods' Effectiveness. Recognizing that each individual work method could not be systematically analyzed in the time available, it was decided that a representative analysis of the Fastener Division methods effectiveness could best be accomplished by examining the methods utilized in the manufacture of two typical products. The two products selected were: (a) the inserts for the molded plastic SPRING-LOCK, and (b) the No. 2 Standard LINK-LOCK, of which approximately 300,000 are produced annually.

Wire Inserts. Individual operations comprising the manufacture of wire inserts are as follows:

A. Straightening of the stainless steel wire.

B. Automatic forming and assembly on a press.

C. Plating.

D. Inspection.

The wire straightening operation consists of mounting a roll of unstraightened wire upon the supply reel on one of three straightening stations, feeding the wire through a die, and then manually winding the straightened wire on a take-up reel of larger diameter. This operation utilizes three operators who perform the manual winding and the part-time services of two set-up men who mount and take down reels. The supply rolls weigh approximately eighty

pounds, and the straightened rolls approximately forty pounds. The annual load at this work station requires the services of three operators approximately 175 days per year.

Annual Cost of Wire Straightening:

3 operators at $1.10/hr. x 8 hrs./day x 175 days/yr.	$4,620
1 set-up man at $2.25/hr. x 1.15 hrs./day x 175 days/yr.	454
Depreciation and repair of machinery (estimated)	300
Total cost per year	$5,374

Cost per pount of wire:

$5,374/70,000 pounds per yr. $0.0768/lb.

The possibility of eliminating this operation has been tested previously with unsatisfactory results. Although it has been concluded that press "down time" encountered when running unstraightened wire is prohibitive, it is felt that the search for some method of guiding unstraightened wire into the presses should not be completely disregarded.

Until such a method is perfected, it is believed that economies can be realized in the straightening operation. Consideration might be given to placing power-driven mechanisms on the present manually operated take-up reels. It is believed that with power winding, incorporating an electric motor and a slipclutch into each take-up reel, one operator could monitor all stations. The estimated cost of incorporating such a methods change is as follows:

3 electric motors at $100 each	$300
3 slip-clutch drive mechanisms	300
Miscellaneous installation costs	300
Total Cost	$900

Savings to be realized in the first year of operations would be the wages of two operators working 17 days per year, minus the cost of installing the change.

(2 x $1.10/hr. x 8 hr./day x 175 days/yr) - $900 = $2400

Savings to be expected each year after the first, equals $3300.

Should it be decided to install the above method change in the wire straightening operation, it is suggested that the change be incorporated into only one wire straightening machine to begin with. After the initial installation, tests should be made to determine the optimum speed at which it may be operated. Based upon the results of such tests, additional machines may be converted to power winding if more than one is required.

Insert Forming. The method of forming wire inserts is considered highly efficient. The insert presses are run automatically and require only slight surveillance by an operator.

The utilization of one operator to monitor each automatic insert press attracted further attention. While each machine is monitored by a woman operator, all set-ups are performed by set-up men who also mount supply spools and thread the stock into the machines. The operator observes the machine for correct operation, occasionally lubricates the flat cold-rolled wire supply, periodically empties a small catch pan into a larger tote pan, and inspects output by comparing a processed insert with an inspection gauge. To determine the percentage of time spent by the insert press operators in each of the elements of the work task, a study was made utilizing the work sampling method. Some 916 random observations of insert press operators were made. Tabulated data collected are shown in Figure 8-1. The work sampling results indicate that operator time is spent as follows:

Watching machine in operation	24%
Not watching machine, attention apparently on other than assigned machine	46%
Oiling flat wire supply reel	4%
Inspecting output	5%
Shifting completed stock to larger pan	5%
Regulating feed of supply reel	9%
Awaiting set-up or machine repair	7%

From the foregoing data it can be seen that 53% of operator time is spent not watching the operation or awaiting set-up or repair. Initial interpretation indicates that one operator could, under present conditions, monitor two insert presses. It is believed that with slight rearrangements of machine positions and division of operator responsibilities, further economies of operator utilization could be realized. For instance, one operator might be assigned all inspection, lubrication, and stock shifting duties, while other operators are responsible for observing operation of machines and regulating supply wire feed, possibly with a prescribed pattern or sequence of observation.

LINK-LOCKS. Approximately 300,000 LINK-LOCKS are produced annually. Individual operations utilized in the manufacture of LINK-LOCKS are indicated in the Process Flow Charts, Figure 9-22, Chapter 9. As in the analysis of Insert operations, methods used to manufacture LINK-LOCKS were examined from the standpoint of motion and equipment efficiency as well as employee effectiveness.

The automatic punch press method of punching and forming female slides, male slides, "8" cam links, wings, and anchor plates is considered to be highly efficient. Represented in these punch forming operations is evidence of highly refined improvement in methods by combining and mechanizing operations which were previously performed individually and manually. On the other hand, it is believed that production economies may be affected in the improvement of the below-listed manual or manually controlled operations which characterize these type of operations in the Fastener Division.

A. Hex cam --drilling of rivet hole.

B. Hex cam--clipping of one wing retainer hole to facilitate insertion of wing.

C. Hex cam and wing assembly operation.

D. Insertion of wing retainer ring.

E. Crimping of hex cam around retainer ring.

F. Assembly of female slide and wing.

G. Assembly of female and male slides.

H. Spinning of rivet.

I. Burring of rivet.

J. Assembly of female slide to anchor plate.

K. Sizing.

L. Run-through and inspection.

Hex Cam Drilling Operations. The two wing retainer holes are drilled in the hex cam by means of a semi-automatic operation. The press used has two horizontal, opposed, cam-actuated drilling spindles. The drill press is fed by means of a gravity feed chute. Drilling operation is machine controlled as is ejection. The only requirement of the operator is to keep the gravity feed chute supplied.

After this first drilling operation, the hex cams must be degreased before they are processed through the second drilling operation. The rive hole is drilled on a single spindle, vertical drill press, utilizing an air chuck work-holding device. This operation is manual.

After rivet hole drilling, the hex cams are moved to a bench work station where a portion of one wing retainer hole side wall is clipped away to facilitate insertion of the wing. This is also a manual operation.

It is believed that by mounting another drilling head on the present two-spindle press which would be capable of drilling the rivet hole and routing out the wall of one wing retainer hole, one degreasing operation, the present rivet hole-drilling operation, and the clipping operation could be eliminated. This modification was discussed with the Designer and the cost of such an installation was estimated to be less than $1,000. The labor savings per year would probably exceed that amount.

Remainder of Manual Operations. Upon observing operations C. through K., numerous points were observed where suggestions could be made for improving work place arrangement, use of tools, and work motion patterns. It was not unusual to find two workers, seated side by side, performing the same operation with different work place arrangement and motion patterns. It is felt that this

group of operations and the methods by which they are accomplished represent that category of Fastener Division methods which have not given sufficient cause in the past to be allotted time and energy for analysis and improvement.

Some specific suggestions might be:

A. In the hex cam--wing assembly operation, the use of a light duty foot-press in place of the mallet warrants further study. Also a drop-delivery chute to the tote pan would save operator effort.

B. Combine the wing retainer ring insertion operation, now performed at a bench, with the punch press crimping operation.

C. For the female-male slide assembly, a work-holder with an open horizontal channel along the top into which the female housing slides might be considered. The work-holder would have a right foot-operated clamp which would grasp the anchor end of the female (to the operator's right) and also provide an indexing stop for positioning of the male slide when inserted. On top of the holder there should be two vertical lugs which position the wing when the female slide is placed into the work-holder. Also, provide a light duty left foot-operated lever or press head to depress the rivet through the "8" cam link and the hex cam. Provide drop delivery or gravity delivery to tote pan.

For rivet spinning and burring operations, design another position on the rivet spinning press to provide for a quick, simple pressing of the spun rivet head immediately following the spinning stroke. Under the present method, the rivet is spun, placed on a table, and another operator picks it up and taps the burr off the rivet with a small hammer. With the added position on the press, the rivet would be spun, moved immediately to the new position, pressed lightly, and dropped into a pan. Several other press operations such as this were observed where the operator was required to reach out in order to place the completed part in a receiver when a simple drop chute would save much effort.

Methods Discussion. Generally, manual operators are not assigned permanent jobs. Due to the variety of products and the varying run sizes, few work assignments are consistent or of long duration. Relatively short production runs and a random element in worker-job assignment are believed to be the underlying cause of most inefficiencies

observed. Therefore, it is felt that the first step in improving methods of manual operations is to stabilize worker assignment wherever possible. Assignment of a specific team of workers to the LINK-LOCK manual operations each time they run seems quite feasible. The same approach could be applied to other products as well. In this manner, consistency of performance and increased operator proficiency through specialization would take care of many methods inefficiencies. With more permanence in work task assignment, workers may also be expected to come up with useful ideas of their own for improving methods employed.

The second step is to make organizational provision for methods design and improvement. The addition of an Industrial Engineer to the staff of Simmons Machine Tool Corporation should take care of this problem. The Plant Superintendent and the Assistant Plant Superintendent have many good ideas for methods improvements, but their other duties do not permit much time for reflection upon this subject. With the proposed plant layout and improvement of the material control system, these two men should have more time for such matters as methods. It is believed that the Plant Superintendent and his assistant, working with a Staff Industrial Engineer, would form a very effective team for improving Fastener Division methods.

Thirdly, a definite schedule of operations to be analyzed for methods improvement should be established and systematically carried out. The procedure for analysis should provide for:

A. The challenging of every detail.

B. Elimination of every unnecessary work element.

C. Changing of the sequence of work elements to achieve economy of effort.

D. Combination of work elements to reduce movements.

E. Simplifying all work elements that remain by the use of:

    1. Principles of motion economy.
    2. Efficient work place layout.
    3. Labor-saving devices, such as work-holders, foot levers, gravity feed of materials, and drop delivery chutes.

F. Worker participation through orientation and training of operators to look for own improvements.

8.3.2 Standards. The primary goal in standards setting is to provide a sound basis for preplanning which, in turn, provides more realistic scheduling. Achievement of proper performance of a work task through the use of effective control procedures is completely dependent upon the accuracy of the work task time standards upon which the control is based.

The time standard is the information necessary to identify the job together with the time allowed to perform it. It may vary in detail from entries made on an operation routing sheet to a finely detailed description of each element of each work task.

Three techniques have been used for determination of time standards. These are estimates, historical records, and work measurements.

Estimates. Experience has shown that no individual can establish consistent and realistic production standards by the simple procedure of taking a look at a job and then judging the amount of time required to perform it. Over a period of time estimated values deviate substantially from true standards. Both historical records and work measurement techniques will give much more accurate values than will the use of estimates based upon judgment alone.

Historical Records. Under the historical method, production standards are based on the records of similar previous jobs. This technique tells how long it took to do a job but does not tell how long it should have taken.

Work Measurement. Any of the work measurement techniques presently used in industrial studies represent a better way to establish realistic production standards. These techniques consider each detail of the work and its relation to the normal time required to perform the entire cycle.

In order to predetermine production times and costs, so necessary from the standpoint of submitting cost estimates, bid quotations, and delivery rates, it is essential that cost of the various direct and indirect materials,

labor, and the production time be predetermined. Predetermined material costs can be accurately determined. Predetermined labor cost and production time can also be readily computed if true time standards developed by one of the work measurement techniques are available.

Use of Standards in the Fastener Division. Recorded standards, as such, are not utilized in the Fastener Division. The only recorded data kept which approximates standards are the product blueprints. The blueprint, or detail drawing, may be considered a product standard in that it prescribes what is to be made, material to be used, and tolerances permitted; however, it is not a standard which can be used for such production planning and control.

Shop scheduling in the Fastener Division is based upon estimates of production rates made by the Plant Superintendent. By not using some system for recording essential production data upon which sound planning must depend, it is felt that management is depriving itself of a fundamental tool for planning and control. Without standards, realistic cost estimates cannot be made, production times for scheduling cannot be accurately predicted, and worker performance cannot be properly controlled.

In attempting to determine the effect which operating without some system of standards has upon production, the following observations were made:

A. Reliable shop scheduling appears extremely difficult.

B. Once initial quantities of material are introduced into the production process, control begins to deteriorate until supervision is burdened with the task of expediting.

C. Worker assignment contains an element of randomness resulting from lack of planned material availability at machines.

D. Actual worker supervision is spread thin as a result of the excessive time required in coordinating material flow to individual work stations.

E. Cost of production is not directly known, and price estimates are made in an indirect manner.

For operations performed on certain machines, primarily the automatically controlled machines, automatic counters record output. Production data for manually controlled operations are not determined. Control of manual operations is therefore limited.

The standard of performance for manual workers in the Fastener Division is not formally established. Workers do not have quotas or definite amounts of output assigned as a guide against which to work.

To determine the effectiveness of work utilization under existing conditions of supervision and control, a study of the activities of workers at manual or manually-controlled operations was made using the work sampling technique. The occurrence of four categories of work and non-work activity were recorded:

A. Worker performing the repetitive or basic portion of the assigned work task.

B. Operations incidental to the work task proper, i.e., rearranging material at workplace, adjusting tools, shifting material or container, etc.

C. Idle. Not performing work, talking to another worker, and personal needs.

D. Absent from assigned work station.

Tabulation of data collected during manual worker activity study.

Activity	Number of Observations	Percentage Occurrence	Hours per Day
Work task proper	850	66%	5.00
Working at other than Work Task Proper	134	10%	0.76
Idle	207	16%	1.21
Absent	100	8%	0.61

(Continued Next Page)

Activity	Number of Observations	Percentage Occurrence	Hours per Day
Authorized Rest and Clean-up	XXX	XXX	0.42
Totals	1291	100%	8.00

(Error less than 2.6% at .95 confidence level)

The data indicates that, on the average, manual workers apply themselves to the basic portion of their work tasks 66% of the scheduled work hours. Whether during that 66% of the time employees work at a fast, slow, or medium pace could not be evaluated objectively due to non-availability of production statistics. In short, it might be said that management has very little knowledge of what labor value it is receiving in return for wages paid. Little improvement can be expected in this area until some system of performance recording and standards have been introduced.

Discussion. A two-phase program is suggested for use in the Fastener Division. The first phase is designed to provide the immediate means with which more accurate scheduling of production may be achieved through the use of temporary standards. Phase One is intended to provide interim standards for quickly achieving improved control. Phase Two is intended to be incorporated at some later date, after provision has been made for systematic methods analysis, and will provide for a permanent standards system. Phase Two includes a description of individual operation methods, a system of recording production output at various stages, and a more precise method of work measurement and standards setting.

Phase One. The establishment and recording of temporary time standards, requires the following information for all parts and products produced.

Part Name
Part Number
Drawing or Specification Number
Operation Description
Work Station and Equipment Required
Time per Hundred Pieces

Figure 8-2 is an example of how such information may be simply recorded.

Times for machine controlled operations can be derived directly from machine cycle counters, or computed from known machine speeds.

Times for the manual operations may be estimated as follows:

A. Select an operator who possesses reasonable proficiency on the operation in question.

B. Time 15 to 25 uninterrupted operation cycles at her normal work pace.

C. Divide elapsed time by the number of cycles completed to determine the unit cycle time.

D. Divide unit cycle time by 0.66 (which is the percentage of time this activity may be expected under present conditions) to determine the present standard.

(Note of caution: The above procedure is offered as a temporary expedient to obtain estimated standards quickly. The same figure would be expected, on the average, if each operator's daily output were known and divided by the time supposedly spent on the job, 7.58 hours per day. This estimating procedure should not be considered a precise measurement in that the 66% figure is an average, and how closely an operator selected for timing actually compares with "average" is highly subjective on the part of the person doing the selection.)

Each standard set by the above procedure should be identified in some manner as interim.

Phase Two. Ultimate Standards Program for the Fastener Division. It is felt that Phase Two of the standards program for the Fastener Division would be most effective if the provision for systematic methods analysis, recommended previously, were incorporated first. Required under Phase Two are:

A. A detailed description of the improved method. Each operation involved should be described in detail after the method has been analyzed and improved. This description will become a factual record of the approved method for each work task.

B. A system of determining individual operator output should be established. Using the LINK-LOCK illustration again, it can be seen that three points in the process exist where it would be convenient and practical to record actual production counts. These three points are: at the punch press where automatic counting is available, after return of parts from plating when parts are introduced into assembly phases, and after completion. By having each operator record on a simple form the time spent on a given run of parts, a record of operator time per part processed is available. This will provide the operator-production data upon which more precise standards can be based and with which production control can be realistically accomplished. A production clerk is presently employed who could handle the collection of data described here with a very slight modification of present duties.

C. A program of work measurement should be undertaken, utilizing the production data collected in (B) above and, preferably, the work sampling technique. The work sampling technique is recommended for measurement in that among various other reasons, data can be collected by relatively unskilled personnel, and its application is less disconcerting to the worker.

D. Computation, recording and publishing of standards obtained.

With these standards, determined as suggested herein, production planning and control and costing can be accomplished on a more reliable basis.

8.4 Recommendations. It is recommended that:

1. Worker assignment be stabilized wherever possible.

2. An Industrial Engineer be assigned to the staff of the Simmons Machine Tool Corporation.

3. A systematized program of methods improvement be established.

4. A program for providing interim standards be implemented immediately.

5. Replace the interim standards ultimately with refined engineered standards.

TABULATION OF DATA COLLECTED IN THE STUDY OF INSERT PRESS OPERATOR ACTIVITY

Activity	Number of Observations	Percent Occurrence	Hours per Day
Watching machine	216	24%	1.82
Not watching	420	46%	3.48
Oiling flat wire	33	4%	0.31
Inspecting	48	5%	0.38
Shifting	48	5%	0.38
Regulating stock feed	86	9%	0.68
Awaiting set-up/repair	63	7%	0.53
Authorized rest and clean-up period	XXX	XXX	0.42
Totals	916	100%	8.00

(Note: Percentages are rounded off to nearest whole percent.)

Percentages in this table have no greater than 3.3% error at a confidence level of 95%.

Figure 8-1

Part No.: _____ Date: _____

Part Name: Female Slide (LINK-LOCK)

Drawing or Spec. No.: _____

Operation Number	Description of Operation	Work Station and Equipment Required	Time per 100 pcs.
	Blank and Form	Punch Press Die Set No._____	xxx
	Wash	Washing Station	xxx
	Tumble	Tumbling Barrel	xxx
	Heat Treat	Out of Division	
	De-scaled	Tumbling Barrels	xxx
	Plated	Out of Division	
	Assembled to Wing-Cam	Multi-Press	xxx
	Assembled to Male and "8" Cam	Assembly Bench Mallet Drift Die	18.17 min.
	Rivet Spinning	Foot Controlled Spinning Press	xxx
	Rivet Burred	Bench, Hammer	xxx
	Assembled to Anchor Plate	Air Press	xxx
	Sized	Punch Press	xxx
	Inspected	Bench, jig	8.5 min.

STANDARDS DATA SHEET

Figure 8-2

CHAPTER 9 - PROCESS FLOW AND PLANT LAYOUT

9.1 Introduction. The nature of the physical plant and facilities must be recognized as the basic factor in determining the industrial character of a manufacturing operation. The plant facilities comprise a set of operating constraints within which the business must be conducted. These constraints in a large measure determine the manufacturing processes used, the flow of materials, the interplant relationships between the various operating and staff departments, the effectiveness with which planning and control of production may be exercised and, in the overall sense, the ultimate efficiency and profitability of the entire enterprise.

In consonance with the above considerations, the overall objectives of this section of the report were formulated as follows:

A. Define the present plant facilities.

B. Analyze the present process flow and the layout of facilities to establish the major points of weakness.

C. Develop suggested corrections for these weaknesses which would result in the greatest immediate improvement in operations.

9.2 Process Flow.

9.2.1 Machine Tool Division. In a true "Job Shop" such as the one under study there can be no real process with the exception of the manufacture of the "SKY-PARK". However, it is equally important to note that in any job shop where the machinery has a relatively fixed position and the work is of a fundamentally repetitive nature, there exists a predominant work flow pattern. While this flow pattern is by no means as obvious as in a production shop, it nevertheless exists in a tangible form and is subject to determination and analysis. It is important to realize that the job shop work flow is as subject to bottlenecks as is the product flow line in a production shop. It is possible for any of the major tools in a job shop to become

a bottleneck due to the widely varying sequence in which work is routed through the shop. It is also significant that the same long range economic factors apply to the production scheduling and the resulting work flow in a job shop as in any other productive enterprise. These basic economic factors are:

A. The degree of success in shipping completed work in compliance with delivery deadlines.

B. The rate of turn over of working capital, i.e., the rate of movement of the working capital invested in materials in progress.

C. The amount of profit margin generated in terms of all personnel, equipment and invested capital.

Plan for Analyzing the Work Flow. With the factors which were set forth in the preceding paragraph in mind, it was decided to study first the present plant layout and production scheduling techniques, and then determine the predominant work flow pattern in the machine shop. The classical approach to such a problem is the use of a cross chart to determine the amount of movement between each of two operations or areas. Each move is recorded in the appropriate "from" and "to" column and the moves from each activity to another are then tallied and totaled. From these totals it is then possible to determine the predominant work flow pattern and the best relative arrangement of machines, operations, and areas for improved plant layout. Normally, these moves are determined from job routing cards or other suitable records. In this shop, however, it was difficult to determine work routing for the following three reasons:

A. Route cards are not used.

B. No formal production scheduling is currently used.

C. Job Tags, the only "paperwork" presently used, do not indicate the routing of the part concerned.

To overcome this lack of routing information, as well as to obtain an indication of machine utilization, it was decided to use sampling techniques.

Development of the Cross Chart. An inventory of work-in-process was taken which revealed that there were only six major types of equipment currently in the shop. This inventory list is presented as Figure 9-1. A list of the machines processed in 1958 was made to use as a basis for determining if the work-in-process was a representative sample. This list (Figure 9-2) revealed that 38 major pieces of equipment and approximately 180 smaller pieces were processed in 1958. A comparison of this annual production and the work in process revealed that the latter was a somewhat dubious sample of the typical work load. Despite this fact, the basic plan of analysis was retained so that some indication could be obtained of the work flow within the plant.

An inventory of all potentially productive machine tools in the plant was taken and is presented as Figure 9-3. Because of the large number of tools and operations involved in the shop, it was decided to group these tools and major operations into types to reduce the size of the cross chart.

Sampling of the work in progress was commenced and Job Tag numbers were recorded as the parts were sampled in order to prevent sampling the same part twice. Because of the limited number of parts in process it was necessary to sample randomly the Job Tags of work completed within the last six months using shop personnel to assist in determining the most probable routing that had been used. Even using this somewhat artificial addition, it was possible to obtain a sample size of only 308 parts. Considering the engine lathes which were the most active operation, the sample size used results in an error of 4.5% at a confidence level of .95. The next most active operation was welding and cutting, with only 24 occurrences as compared to 245 for the engine lathe which results in an error of 3.1% at a confidence level of .95.

The cross chart prepared from this analysis is presented as Figure 9-4. A summary of shop work flow from the cross chart ranked in order of the number of occurrences per type of equipment/operation is presented as Figure 9-5 and shows how rapidly the number of occurrences decrease. Disregarding the fact that the present work-in-process may not be a representative sample, the cross chart does show that the majority of the parts go from disassembly, clean and analysis to the engine lathes and from there to final assembly. The other routings are relatively few in number so it appears that, for the present level of operations, the present shop arrangement is adequate.

9.2.2 Process Flow for "SKY-PARK". The process flow chart for the "SKY-PARK" machines is presented in Figure 9-6. The process flow is of the multiple reverse branching type in which parts are made into sub-assemblies which are routed to final assembly. This chart should therefore be used as a basis for allocation of space and the establishment of the position of sequential work.

9.2.3 Fastener Division. Unlike the Machine Tool Shop which is a true job shop, the Fastener Division is more susceptible for process flow analysis. The basic products (shown in Plate III of the introductory section of this report) come in a variety of sizes and a wide range of modifications. This is particularly true of the molded plastic SPRING-LOCK fasteners manufactured for the refrigerator industry. All of these products are produced by a batch-type manufacturing process to meet current customer needs and only a limited inventory of finished goods is maintained in stock for future needs. It appears difficult to forecast future production requirements and no true production lines have been established to expedite the manufacture of any one product. However, the process used for the manufacture of the metal inserts used in the molded plastic SPRING-LOCK more nearly approaches a product line than do the processes for the other basic products, and with slight modifications, could be converted into a production line.

Plan of Analysis. After a preliminary study of the general plant layout, products manufactured, and overall work flow, it was decided to analyze the process flow as follows:

A. Determine and analyze the process flow of two typical items since all of the basic types of fasteners were not in continuous stages of production during the period of the study. The metal inserts for the molded plastic SPRING-LOCK and the No. 2 Standard LINK-LOCK were chosen because they are both high volume items and were in continuous production throughout the study period.

B. Construct flow analysis charts for these two fasteners.

Process Flow Analysis. The process flow analysis and the summary for the metal inserts for the molded plastic SPRING-LOCK are shown on Figures 9-8 through 9-10. Figure 9-11 is the pictorial presentation of this process flow.

Similar information for the No. 2 Standard LINK-LOCK is contained in Figures 9-12 through 9-22. The distances the product travels inside the plant during the process are presented along with the total number of operations, inspections, transportations, and delays which are summarized at the top of the process analysis sheets. A revised process flow was not attempted because this should be preceded by a critical appraisal concerned with standardizing and simplifying the present products and parts. This type of analysis was considered to be beyond the scope of this study. Further, if process flow analysis was to be used as a basis of a complete plant re-layout it would entail the establishment of process flow analysis charts for all products manufactured. However, by analyzing the process flow for the two items it was possible to arrive at improved relative positions of the individual machines within functional areas. The proposed plant re-layout as shown in Drawing 4 is the result of this analysis. Associated operations within some functional areas approach a product line using batch type flow (discussed in detail in Section 9.3.3).

The distances that the SPRING-LOCK molded plastic insert and the No. 2 Standard LINK-LOCK would travel in the proposed layout was computed. Comparison of the distances traveled inside the plant reveal that the proposed layout has reduced the distance for the metal inserts from 1,246 to 792 feet, a saving of 454 feet. Similarly, the No. 2 Standard LINK-LOCK would travel 5,076 versus 7,192 feet, with a saving of 2,116 feet. It was noted that the plating of the parts for the No. 2 LINK-LOCK fastener was done in Pittsfield, Massachusetts. Although this fact has no effect on the process flow analysis within the plant, it appears to be a potential source of delay in the overall processing time. A study appears to be in order to compare the cost and time factors involved in providing and operating facilities to do the functions presently accomplished outside the plant (plating, heat treat, etc.) with the costs and delays presently incurred.

9.2.4 Recommendations. It is recommended that:

1. The "SKY-PARK" Operations Summary Chart (Figure 9-6) be used in determining space allocation and position of sequential work stations.

2. A study be instigated to determine whether it would be advantageous to provide facilities within the organization to do the processing presently contracted to outside activities.

9.3 Plant Layout.

9.3.1 Introduction. With the exception of establishing the extent and location of the real estate holding of the Simmons Machine Tool Corporation (Drawing 1), this section will be confined to the industrial activity of the Machine Tool Corporation and the Fastener Division located in Buildings 3 and 18 respectively.

The major portion of the effort devoted to this section is represented by the drawing of the real estate holdings, the layout of the Machine Tool Corporation and the present and proposed plant layout of the Fastener Division (Drawings 1,2,3, and 4 in Volume III). It is considered that the drawings contain sufficient detail to make them largely self-explanatory. Accordingly, the written exposition will be only so detailed as is required to present clarifying data to substantiate the analysis and recommendations.

9.3.2 Machine Tool Division - Building 3. Building 3 is devoted primarily to the rebuilding of machine tools. It is a typical industrial type steel frame structure 152 feet wide and 362 feet long. The structure is divided longitudinally into three bays identified as A, B, and C on Drawing 2. The two side bays are 46 feet wide with approximately 30 feet of overhead clearance. The center bay is 60 feet wide with approximately 40 feet of overhead clearance. The floor in the rear 60 feet of the building is dropped approximately four feet below the rest of the shop to accommodate the railroad siding. The shop facilities are indicated in Drawing 2. The layout is strictly functional; lathes, milling machines, planers, grinders and the like are grouped in well-defined areas. With the exception of the planers, the majority of the machine tools are located in the north (A) bay. Because of their size, the large planers and surface grinders are located in the center bay (B). The location of the overhead cranes, jib cranes and traveling hoists are indicated in Drawing 2 along with a listing of shop power.

Certain areas of the shop are designated for specific functions. The functions shown on Drawing 2 are those which were in effect on the date when the drawing was made. The location of all installed machinery and facilities is stable; however, the nature of the work in process in the various assembly areas changes from day to day as jobs are phased in and out of the shop. Because of this fact, no effort was made to keep Drawing 2 current. It is to be noted that, in general, the metal cutting,

welding and heat treating functions are accomplished in the east end of the building. The machining functions are confined to Bay A and the west end of Bay B. The electrical shop occupies the west end of Bay C. Remaining areas are designated for disassembly, assembly and storage of parts awaiting processing.

Analysis of the Present Layout of Building 3. The machine shop in Building 3 is typical of a job shop in the heavy machine tool industry. The installed machinery and facilities are more than adequate for the work being performed and the shop personnel show considerable ingenuity in adapting the machines to the work at hand. Adequate shop power and air are available. Materials handling is accomplished primarily by the overhead cranes. The number and capacity of overhead cranes, jib cranes and traveling hoists is adequate for the work in process.

It is concluded that under the present circumstances there is little to be gained by any change of layout in Building 3. The present functional layout is considered adequate. Utilization of areas could be improved by the removal of unused machinery; however, this is of small importance at the present time. Some gains may be made in the area of better organization of the assembly and storage spaces.

The main improvement in operational efficiency in the machine shop may be made in the "SKY-PARK" assembly. At the present level of operations (40 units being constructed) it would appear profitable to set up a modified assembly line with areas designated for sub-assembly, accumulation of parts and final assembly. The designation of specific contiguous areas in Bay C for all "SKY-PARK" operations, beginning with cutting and welding and ending with approximately 10 final assembly stations, is considered an appropriate solution. It is interesting to note that during the period which the plant was under observation, the "SKY-PARK" area has evolved into roughly this sort of arrangement. The arrangement developed through several stages of limited organization as the job progressed and emerged as a recognizable station assembly operation only with the advent of final assembly. It is considered that a preplanned operation would have contributed materially to the ease of scheduling the "SKY-PARK" operation through the shop.

9.3.3 Fastener Division. The Fastener Division occupies Building 18 which is a Quonset type structure located along the east side of the Simmon's industrial properties adjacent to the right-of-way of the Delaware and Hudson Railroad. The building is about 10 years old and in adequate repair. It is constructed in an L shape and the main part of the structure consists of four standard 40-foot Quonset sections placed side by side and joined overhead to form four bays. The two outside bays are 30 feet wide while the two center bays are 20 feet wide. This portion of the building is 100 feet long. A single 40-foot Quonset section extends 140 feet south of the east bay and forms the leg of the L. The entire building covers an area of approximately 16,000 sq. ft. The structure is single story with the exception of a drafting room and loft located in the main section over the offices and wash rooms. Approximately one half of the floor space is devoted to manufacturing; the remainder is used for offices and supporting services.

In contrast to the Machine Tool Division, the processes in the Fastener Division are largely simple, repetitive and performed on production machinery. The types of machines installed are typical of a small metal parts fabricating plant. They include punch presses, drilling machines of various types, shear presses, wire forming presses, resistance and spot welders and the like. A complete complement of tooling may be derived from Drawing 3.

Present Shop Layout. Drawing 3 portrays the present plant layout and was developed from a survey of the building and equipment. The machine outlines represent the floor space it requires (i.e., the projection of the machine outline on the plant floor). The machines are positioned as accurately as reference to the structure of the building permitted.

The functional divisions of the plant area are indicated on Drawing 3. The northwest bay is occupied by the machine shop which services the production machines. The production area (parts manufacturing, assembly and inspection) occupies the remaining bays in the main section of the building and approximately one third of the south wing. The remainder of the wing is devoted to storage and a small Shipping and Receiving Department.

Analysis of the Present Plant Layout. The present layout of Building 18 as shown by Drawing 3 is typical of a non-engineered plant which has experienced a period of ex-

pansion without adequate planning. It appears that the requirement for continuing operations while modifying the shop to accommodate new items and increased production has been the overriding consideration. The location of the machines and other facilities appears to have been dictated by space available rather than the more stringent requirements of efficient operation. This is amply demonstrated by the scattering of machines throughout the storage area, the installation of production machines in the machine shop and the random distribution of assembly and inspection benches.

There is evidence, however, that the layout of some areas have been given considerable thought and planning. The arrangement of the insert presses, for example, demonstrates most efficient use of space. The same may be said for the two-spindle production drill presses.

A major problem in the Fastener Division is the lack of adequate material control. This is immediately apparent to the casual observer. Practically all the floor space shown in Drawing 3 which is not occupied by machines or facilities is stacked with stored material. Finished goods, purchased parts, work-in-process and raw materials are intermixed. The result is an extremely cluttered appearance. The Company considers that a shortage of storage space is their primary problem and is considering an 80 foot extension on the south wing.

Upon analysis of the Company's facilities, it appears that the true problem is not so much the lack of space as it is the inefficient use of available space. Further analysis indicates that the fundamental reason for inefficient space utilization is that there is no adequate means for lifting and transporting material. Everything in the plant from tote pans to steel coils weighing 300 pounds or more must be handled manually or by hand lift trucks. For this reason, the material appears to be stored as close as possible to the point of intended usage. The cluttered condition of the plant is considered to stem from this situation. The resulting lack of material control requires the constant attention of the Plant Superintendent and his assistants.

In view of the above situation, it is concluded that the primary objective of any improvement in shop layout should be to provide the facilities for adequate material control. For purposes of this discussion, material control is considered to incorporate material handling, storage and

inventory control (including receiving and issue). This section will not set up the procedures but rather will discuss the physical facilities essential to the operation of a material control system. The detailed procedure analysis is covered in Section 7.1 of Chapter 7.

Development of the Proposed Layout. In analyzing the present shop layout, the major objective was to provide physical facilities upon which to base an efficient material control system. This was to be accomplished utilizing the existing plant and equipment keeping the addition of facilities to a minimum. The secondary objective was to improve the process flow during the rearrangement of the plant by dividing it into the functional divisions of parts manufacture, assembly, inspection, storage, receiving and shipping, and machine shop.

Analysis. Fundamental to a material control system is the existence of physical facilities to store material in an orderly fashion. This permits a system of controls to be imposed on the receipt, storage and issue of materials. The second major requirement is to provide the means of handling these materials.

The second requirement was considered first since the placement of the storage area would be dependent on how the material handling problem was solved. An analysis of the types of material to be handled indicated a requirement to pick up and transport material up to a maximum size of a three foot cube and maximum weight of 1,000 pounds. It was decided that a small fork lift truck would satisfy these requirements. This is a mandatory requirement upon which the entire proposed plant layout has been predicated.

Operation of the fork lift truck throughout the plant will require an increased aisle width; accordingly, an aisle approximately 8 feet wide is specified for the entire length of the building from the loading dock to the north end and extended westward to service the center bays. The entire facility rearrangement is built around this access aisle.

The material control area was established based on estimates of the normal space requirements for the office, shipping and receiving, and storage. The assembly room at the south end of the building has been designated as an office for the personnel charged with the material control responsibilities. Drawing 4 shows this office set-up with minimum facilities. Since personnel occupying this space

will be concerned with shipping, receiving and material storage, these facilities are located adjacent to the office in the first 25 feet of the building north of the shipping dock reserved for the use of shipping and receiving. This area provides approximately 350 sq. ft. of floor space encompassing the presently installed weight count scales and furnished with two small weight-count scales (one installed on a roll table to be used throughout the storate area), a platform scale, a paper shear and three benches. Adequate open area is provided for temporary storage of material awaiting immediate loading. The packing materials may be stowed in the adjacent storage area.

In the design of the proposed storage area the object was to provide maximum concentration of material with good accessibility. Storage racks were designed for modular construction based on the use of slotted steel angle sections, one type of which is manufactured by Orchard Bros., Inc. of Rutherford, New Jersey, and marketed under the trade name "ERECTANGLE". The standard modules were designed to accommodate all storage containers known to be used by the Fastener Division. The standard module is 10 feet high, 4 feet wide and 4 feet deep. The first shelf is spaced three feet above the floor and the succeeding three shelves are at two foot intervals. This spacing will accommodate four barrels on the floor below the lower shelf and 96 cu. ft. of box storage on the three upper shelves. The racks used on the east side of the storage area are constructed to incorporate four such modules which will accommodate 16 barrels and provide 384 cu. ft. of box storage plus space for additional storage above the top shelf. Six such units plus a rack one-half module deep and three modules long are spaced 42 inches apart along the aisle. All or part of these units can be made secure storage by the installation of a proper barrier. Racks on the west side of the aisle consist of three modules similar to those on the east side except that the module is three feet four inches wide vice four feet. These racks will accommodate 10 barrels and provide 240 cu. ft. of shelf storage. All of the racks on both sides of the aisle will store a total of 126 barrels and provide approximately 3,000 cu. ft. of shelf storage plus 528 sq. ft. of storage area on top of the racks. By utilizing the space between the ends of the racks and the outside wall and stacking barrels two high, an additional 40 barrels can be stored and be accessible. A preliminary cost estimate for building all these racks out of "ERECTANGLE" sections with shelves of 3/8 inch plywood is approximately $2,000.

The storage area terminates at the sixth rack on the east side of the aisle but extends down to the utility area on the west side. This additional area is used for storing purchased hardware in 16 storage bins which were moved from the north end of the building, an "ERECTANGLE" tote pan rack with a capacity of 90 pans for work-in-process storage, and storage of steel strip coils. A minimum of 186 coils of steel strip can be stowed on skids in this area in stacks of six. Additional storage can be made available by increasing the height of the stacks.

With the facilities for the material control system established, the remainder of the plant was laid out into functional areas as shown on the general layout diagram in Drawing 4. This layout is intended as a suggested arrangement only, following the basic objectives set forth previously.

The next critical problem was the placement of the heavy punch presses (Thomas, Toledo 60T, Toledo 30T). Placement of these presses is complicated by the requirement for power feed from material reels. Due to the weight of the coils, these reels should be accessible for servicing by fork lift truck. The truck must have access to the reel from the storage area and it is proposed that the same truck that delivers the material also load it on the reel using a sling attached to the fork. Reference to Drawing 4 will show how these requirements were met by removing the unused tote pan storage racks between the center bays. The Bliss 20T presses were also positioned where they are accessible for servicing by fork lift truck. The remainder of the bay was filled out by the addition of the shear presses, DoALL saws and a curtained welding area.

The insert presses were realigned slightly to provide for a three-foot aisle through the bay. By removing the sheet metal and bar stock storage rack, space was made available for installation of the wire straightening machines which are associated with the insert presses. The storage rack was moved to a position near the large door along with the power hack saw used in conjunction with the rack. The aisle area in front of the door allows end loading of the rack and the cutting of long lengths of bar stock. The metal hand shear and brake were placed behind the Toledo 60T press reasonably near the metal storage rack.

The northeast corner of the plant was designated as the material cleaning (degreasing, descale, deburr, brighten) area. The tumblers are already in this area and

it was considered appropriate to keep the relatively "dirty" operations in a remote location as far away as possible from the other operations in the plant. The degreasing tanks were shifted to a position against the north wall adjacent to the wet tumbler. This location places the associated processes near each other and permits venting the steam-heated degreasing tanks to the outside through the vertical end wall of the building. Storage space for the cleaning materials used in the descaling and cleaning process is provided in this area. Although space is designated for 12 barrels, more can be stored if required. A storage rack for four 55-gallon oil barrels is placed along the north wall between the door and the degreasing tanks. This location was selected for storage of the cutting, machine and hydro oil and the cleaning solvents with safety and cleanliness factors in mind.

The eight two-spindle production drilling machines are shown relocated in two lines perpendicular to the aisle in the east bay. The machines are arranged for chute delivery of the finished parts to the three foot center aisle between the machines. Operator positions are indicated on the drawing on the outboard sides of the respective machine lines.

Moving the drilling machines and relocating the degreasing tanks clears the newly established aisle in this area and permits free access to the tote pan storage racks presently installed between the east and center bays. Accessibility to the tote pan storage was a major consideration in establishing the aisle position.

The pattern established by the location of the drilling machines is carried throughout the remaining parts of the manufacturing area. In general, the machines and benches are set in lines perpendicular to the main aisle. Like machines are grouped into functional lines with a minimum separation of four feet on the operator side of the line. The arrangement of the Diamond and Toledo presses on the east side of the aisle is modified slightly from the cross line arrangement previously specified to permit feed from material reels. Heavy production machinery such as the Simmons Micro-speed turret lathes, the welders and the large assembly press are located along the east wall. These machines are interspersed with the small utility machines which are used infrequently. All machines were positioned so as to provide the necessary clearances (specified by the Plant Superintendent) for material feeds. In the more critical cases such as the Simmons turret lathe and the

Maco punch press, the required clearances are shown on the drawing in dotted lines. In this particular area the same dead space was made to serve as material feed clearance area for the Maco and Diamond punch presses and the Simmons lathe. These machines are not used continually and need not operate simultaneously if properly scheduled.

In the assembly area, the line arrangement of machines and equipment by function is carried on in the same manner as in the parts manufacturing area. The assembly benches are grouped in pairs with each pair having an associated foot press or riveting machine (spinner) as in the present shop layout. The benches and equipment on the aisle side of the heavy assembly machinery are not permanently installed and may be moved as required to permit access to or removal of the heavy equipment installed along the wall. While the varied nature of the assembly operation mitigated against any product line considerations in the layout, the natural association of like machines has provided many incidental improvements in materials handling and process flow. For example, the two benches, a riveting machine, a Dennison Multi-press, an assembly (sizing) press, and a compressed air operated press utilized for the No. 2 Standard LINK-LOCK are now all located adjacent to each other. The roller assembly presses are utilized in a specialized process not associated with other operations in the plant and are therefore placed at the extreme south end of the area. These presses were moved out of the assembly room at the end of the building to make room for the office. The torqueing machine is relocated on the aisle in this area because of its special servicing requirements.

Analysis of the current operations indicates that a considerable portion of the inspection function is performed incidental to an assembly operation; therefore, it is considered that the pure inspection operations can be accomplished on a maximum of four benches. These benches are located between the assembly area and the storage racks and are arranged to permit access to three sides. Since the majority of parts inspected are obtained from purchased parts storage or are inspected following outside processing (heat treat, plating, case hardening) it is considered appropriate to locate the inspection area near the shipping dock and the material storage area.

The majority of the items inspected are handled in tote pans so a tote pan storage rack is provided on the aisle side of the inspection benches to accommodate 48 pans. This rack is conceived as a pass-through type that may be

serviced from the aisle with sections designated for incoming and completed work. An additional tote pan storage rack which will accommodate 90 pans is located directly across the aisle in the storage area. Use of this rack for temporary storage of parts in process will eliminate the present clutter on the deck of the manufacturing area. It is considered that this storage together with the now accessible built-in tote pan racks at the north end of the building should handle adequately the tote pan problem. The tote pan storage racks in the parts manufacturing area should only be used for temporary storage of parts in process awaiting movement to the next operation and each tote pan should be conspicuously labeled as to its contents.

A comparison of the approximate breakdown of space utilization between the present plant layout (Drawing 3) and that proposed in Drawing 4 is as follows:

	Present	Proposed
Parts Manufacturing	6,400 sq. ft.	6,000 sq. ft.
Assembly	2,100	2,100
Inspection		300
Shipping and Receiving	650	650
Storage	2,700	2,550
Machine Shop	2,050	2,050
Office	1,200	1,450
Utilities and Rest Rooms	900	900
Total	16,000	16,000

In the proposed layout the entire manufacturing area of the building has been used and to derive the full benefits from this layout, continuous efforts must be devoted to maintaining good housekeeping procedures. Personnel must be made available to handle material and deliver it from the storage area to the machines and vice versa.

Incidental to the study of plant facilities it was apparent that an extension of office space will be required if this organization continues to grow. The manu-

facturing area can stand no further encroachment for office spaces and any further expansion should be planned by the addition of a 40 foot Quonset section south of the present offices! This could also be used for the addition of a reception and sales office which appears to be required at the present time.

If and when a plant relayout is made, it is suggested that it be accomplished in the order in which the various aspects of the layout have been discussed. The first area of improvement should be that comprising the facilities for a coordinated material control system. When all of the material has been screened and stored in an orderly manner the tote pan storage racks should be removed from between the center bays and the heavy punch presses should then be relocated. The remainder of the punch press bay can then be completed followed by the insert press bay. Adequate area will then be available in the northeast corner of the plant to move the production drilling machines and the equipment at both ends of this present installation. This will provide the required aisle down to the inspection benches near the wash rooms. The Simmons Micro-speed lathes can then be moved into position and the remaining smaller machines can be relocated as necessary. This should result in the minimum "down" time for any machine and plant production should be able to continue (perhaps at a reduced rate) while this change is being made.

9.3.4 Recommendations. It is recommended that:

1. Large repetitive jobs in the Machine Tool Division, such as the current "SKY-PARK" order be analyzed in advance to determine the space requirements for the various manufacturing and assembly operations.

2. Space be allocated incrementally on a planned basis as these large repetitive jobs develop to provide for orderly and systematic accumulation of parts and subassemblies and their flow into a final assembly station.

3. A 1/2-ton capacity fork lift truck be procured prior to any rearrangement of the Fastener Division plant.

4. The storage facilities necessary to establish a coordinated material control system within the Fastener Division be provided without delay.

5. The remainder of the manufacturing facilities of the Fastener Division be relocated in accordance with the objectives of this analysis. (Drawing 4 is submitted as a proposed approach.)

6. Any anticipated expansion of Fastener Division office space be made by expanding the building and no further encroachment be made on the existing manufacturing area.

MAJOR MACHINE TOOLS IN PROCESS - MACHINE TOOL DIVISION

(As of March 1959)

Quantity	Description
1	60" Farrell Birmingham Roll Grinder
1	32" Farrell Birmingham Roll Grinder
1	14' x 20' Niles Vertical Boring Mill
1	48" Niles Planer
1	Newark Gear Hobber
1	#12 Gisholt Automatic Production Lathe
3	#3100 Simmons Gear Boxes

Figure 9-1

MAJOR EQUIPMENT REBUILT/MODERNIZED/REPAIRED OR MANUFACTURED DURING CALENDAR 1958

Quantity	Description
	LATHES
1	2H8 Libby Turret Lathe
1	42" Bullard Vertical Turret Lathe
1	36" Bullard Vertical Turret Lathe
1	36" American Lathe
1	Sidney Lathe
1	48" x 30' Niles Lathe
2	48" Niles Lathe
1	#2 Medart Lathe
1	60" Niles Lathe
1	5H8 Libby Turret Lathe
	BORING MILLS
1	10' Cincinnati Vertical Boring Mill
1	14' - 20' Niles Vertical Boring Mill
1	72" King Vertical Boring Mill
1	9½" Niles Horizontal Boring Mill
1	6½" Niles Horizontal Boring Mill
2	5" Sellers Horizontal Boring Mill
	MILLERS
1	#3 B & S Miller
1	Lees Bradner Thread Miller
1	GE Conductor Miller
1	Defiance Miller
1	#3 Cincinnati Miller
	36" Norton Miller
	GRINDERS
1	42" Mesta Grinder
1	28" Landis Grinder
1	50" Landis Grinder
1	Norton Roll Grinder
1	36" FB Grinder

(Continued)

Figure 9-2

Quantity	Description
	OTHER MAJOR EQUIPMENT
1	96" D & H Planer
1	Kling Shears
1	48" Liberty Shaper
2	#375 Simmons Gear Box
2	Snow Blower Shaft
	MINOR EQUIPMENT

In addition to the above, approximately 180 sub-assemblies and miscellaneous parts, such as gears, lathe parts, boiler valves, split nuts, machine tools, sprockets and the like were rebuilt, modernized, repaired or manufactured during 1958.

Figure 9-2
(Cont'd.)

SIMMONS MACHINE TOOL DIVISION MACHINE TOOL FACILITIES INVENTORY

AS OF MARCH 15, 1959

Quantity	Size or No.	Manufacturer
	LATHES	
ENGINE		
1	54" x 23' cc	N.B.P.
1	30" x 15' cc	Niles
1	26" x 72" cc	Bradford
1	26" x 120" cc	Bridgeford
1	20" x 96" cc	American
2	20" x 72" cc	LeBlond
4	20" x 60" cc	Simmons
2	18" x 66" cc	American
2	16" x 42" cc	American
2	16" x 42" cc	Springfield
2	14" x 36" cc	Hamilton
3	Bench Lathes	
TURRET		
1	54" Vertical	Bullard
1	42" Vertical	Bullard
2	No. 2B	Simmons
1	No. 5	W & S
	BORING MILLS	
HORIZONTAL		
2	5" Spl. No. 45	Giddins & Lewis
1	4" Spl. Floor Type	Lucas
2	3" Spl. Table Type	Lucas
1	6" Spl. Cyl. Boring	Simmons
1	8" x 12' Deep Hole	Barnes
VERTICAL		
1	100" - 2 Heads	Niles
1	60" - 2 Heads	Colburn

(Continued)

Figure 9-3

Quantity	Size or No.	Manufacturer
	GEAR CUTTERS	
1	No. 2A	Farrell-Sykes
1	100" Hobber	G & E
1	72" Hobber	Newark
1	24" Hobber	Adams
1	18" Hobber	G & E
1	72" Spur Cutter	Cincinnati
1	54" Spur & Bevel	Gleason
1	18" Spur & Bevel	G & E
1	11" Generator	Gleason
1	6" Generator	Gleason
2	36" Gear Shaper	Fellows
1	Gear Tester	B & S
1	Gear Tester	Gleason
	MILLERS	
1	No. 5 Plain	Cincinnati
1	No. 4 Universal	Cincinnati
1	No. 4B Plain	Milwaukee
1	No. 3B Plain	B & S
1	No. $2\frac{1}{2}$ Universal	Rockford
1	No. 4 Vertical	Cincinnati
1	No. 3 Vertical	Van Norman
4	Hand Millers	
1	4" x 20' Thread Miller	
	GRINDERS	
1	24" x 20' Cylindrical	Norton
1	10" x 50" Cylindrical	Norton
1	12" x 48" Cylindrical	Modern
1	No. 16 Surface - Rotary	Blanchard
1	Surface-Rotary	O.S. Walker
1	72" x 66" x 40' Surface	Simmons
1	48" x 40" x 10' Surface	Simmons
1	No. 2 Surface	B & S
2	Carboloy Tool Grinder	Cincinnati
2	Tool & Cutter "Monoset"	Cincinnati
2	Drill Grinders	Oliver
21	Bench & Pedestal Grinders	Misc.

(Continued)

Figure 9-3
(Continued)

Quantity	Size or No.	Manufacturer
	PLANERS	
1	9' x 9' x 35' Convertible to 15' width	Simmons
1	96" x 120" x 40' - 4 Heads	Simmons
1	72" x 72" x 18' - 4 Heads	Niles
1	48" x 48" x 30' - 4 Heads	Grays
1	48" x 48" x 24" - 3 Heads	Niles
1	48" x 48" x 66" Hydraulic	Rockford
1	36" x 36" x 66" Hydraulic	Rockford
1	30" x 30" x 8' - 1 Head	Cincinnati
	SHAPERS	
1	32"	Ohio
2	24"	G & E
2	24"	Simmons
2	10" Vertical	P & W
1	20" Vertical	Dill
1	6" Vertical	P & W
	DRILLS	
1	7' Radial	Carlton
1	5' Radial	Hercules
2	3' Radial	American
1	3' Radial	Hammond
18	Upright - Bench & Floor	Misc.
2	No. 420 Deep Hole	Barnes
	SAWS	
1	9" x 9" Hacksaw	Acme
3	6" x 6" Hacksaw	Keller
1	26" Band	DoALL
2	14" Band	Delta
	GENERATORS	
2	100 KW	Westinghouse
2	40 KW	Westinghouse

(Continued)

Figure 9-3
(Continued)

In addition to the foregoing, facilities also include the following:

Welding equipment; electric, stationary, and portable.
Acetylene gas welding and Pantograph cutting equipment.
Gas Generators and Heat Treating equipment.
Chemical cleaning room.
Sand Blast room.
Metalizing equipment.

Figure 9-3
(Continued)

FROM \ TO	Disassembly, Clean & Analysis	Engine Lathes	Turret Lathes	Vertical Turret Lathes	Vertical Millers	Horizontal Millers	Vertical Boring Mills	Horizontal Boring Mills	Gear Cutters	Shapers	Radial Drills	Grinders	Shaft Straighteners	Power Saws	Heat Treat Furnace	Cyanide Harden	Flame Harden	Metalize	Weld & Cut	Sheet Metal Shears	Presses	Planers	Key Slotters	Drill Presses	Fit, Assembly & Test	TOTALS
Disassembly, Clean & Analysis	235	1	4	3	5	1	3	2	3	3	7	7					2	17	2		11	1	1			308
Engine Lathes				20	9		1	13	1				1		3			2		3		14	4		174	245
Turret Lathes																									1	1
Vertical Turret Lathes																									4	4
Vertical Millers		1		1	2					5												13				23
Horizontal Millers																					1	18				19
Vertical Boring Mills						1																				1
Horizontal Boring Mills																									4	4
Gear Cutters					2																1	17				20
Shapers																					1	3				4
Radial Drills																									3	3
Grinders												4													5	9
Shaft Straighteners																									7	7
Power Saws																					1					1
Heat Treat Furnace																										
Cyanide Harden																									8	8
Flame Harden																										
Metalize		1									2															3
Weld & Cut		8													1			1				14				24
Sheet Metal Shears																						2				2
Presses		1																				2				3
Planers																						12				12
Key Slotters						2		2													1	12				17
Drill Presses																						9				9
Fit, Assembly & Test																										
TOTALS	245	1	4	23	19	1	4	20	4	3	9	7	1		8		3	24	2	3	12	17	9	308		

Cross Chart Machine Shop Work Flow

FIGURE 9-4

SUMMARY OF SHOP WORK FLOW FROM CROSS CHART RANKED IN ORDER OF NUMBER OF SAMPLES PER TYPE OF MACHINE/OPERATION

Machine Type/Operation	Number of Samples
Engine Lathes	245
Welding & Cutting	24
Vertical Millers	23
Gear Cutters	20
Horizontal Millers	19
Key Slotters	17
Planers	12
Grinders	9
Drill Presses	9
Cyanide Hardening	8
Shaft Straighteners	7
Vertical Turret Lathes	4
Horizontal Boring Mills	4
Shapers	4
Radial Drills	3
Metalize	3
Presses	3
Sheet Metal Shears	2
Turret Lathes	1
Vertical Boring Mills	1
Power Hacksaws	1
Heat Treating	0
Flame Hardening	0

Figure 9-5

"SKY-PARK" OPERATION SUMMARY CHART

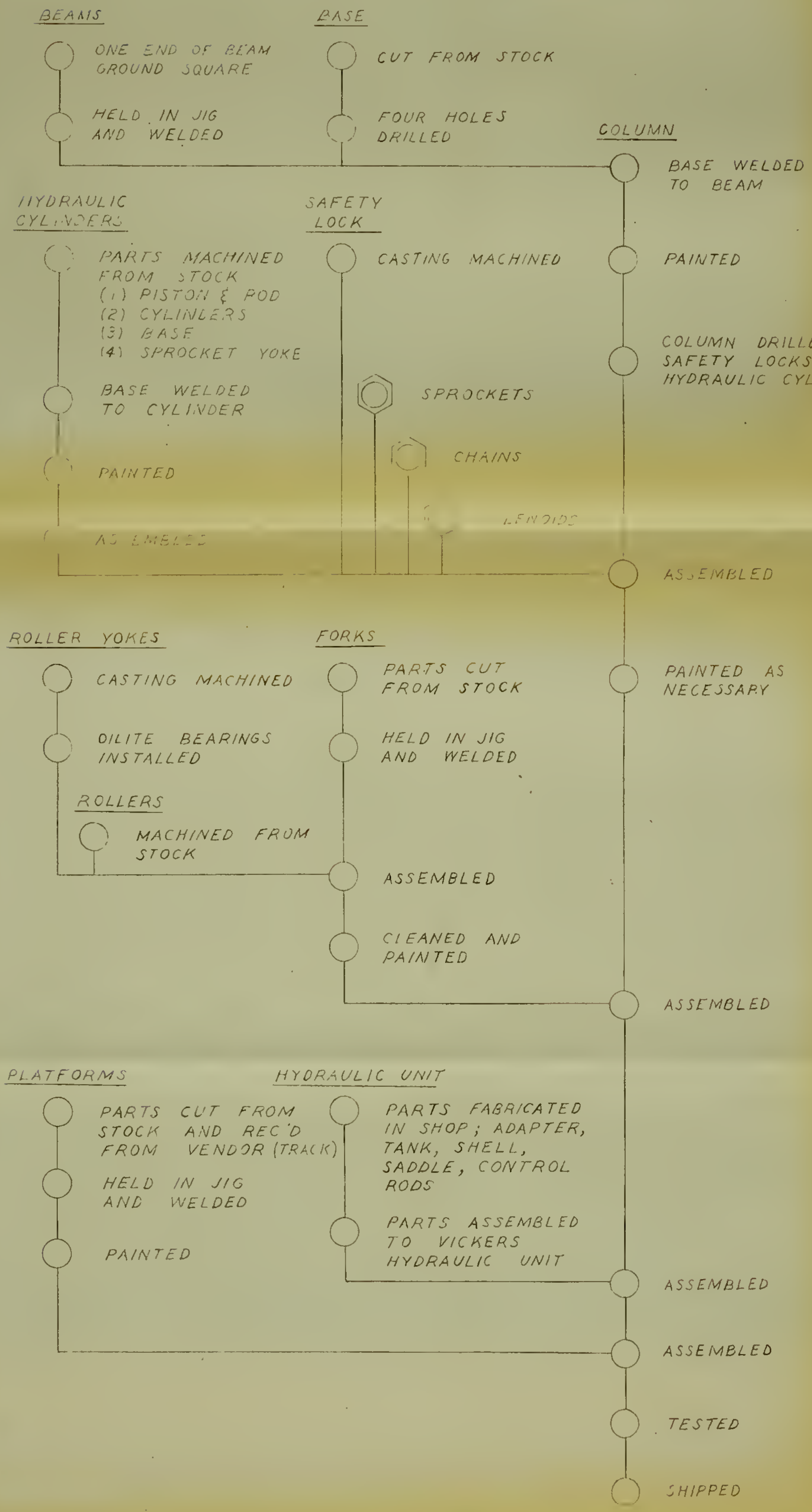
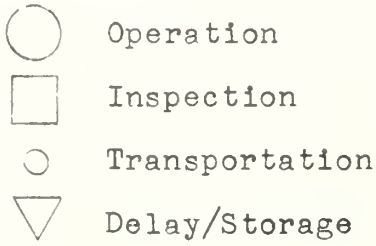


FIGURE 9-6

The following legend is used for the process analysis and flow charts for both the Molded Plastic SPRING-LOCK and the No. 2 Standard LINK-LOCK fasteners:



Note: The process analysis and flow is confined to those operations, inspections, transportations, and delays/storage within the Fastener Division.

LEGEND FOR PROCESS ANALYSIS AND PROCESS FLOW CHARTS

Figure 9-7

PROCESS OR OPERATION ANALYSIS CHART

CHART

~~PROCESS:~~ FASTENER: Molded Plastic Spring-Lock PRESENT METHOD
~~OPERATION:~~ PART: Cold Rolled Flat Wire ~~PROPOSED METHOD~~

SUMMARY

SHEET NO. 1 OF 1 SHEETS

	PRESENT		PROPOSED		SAVING
	L. H.	R. H.	L. H.	R. H.	
No. of O	0				
No. of □	0				
No. of o	2				
No. of ∇	2				
Tot. Steps	4				
Tot. Dist.	200 feet				
Cyc. Time					
Cost/Pc.					

DATE

DEPT.:

OPERATOR:

OBSERVER:

REMARKS:

APPROVED:

STEP	DIST. Ft. ~~In.~~	PRESENT METHOD	O	□	o	∇		O	□	o	∇		DIST. Ft. In.	TIME Hrs. Min.
1		Coiled steel roll in supply												
2	192	To Press Area												
3		Waits need												
4		Placed on machine. (Insert Press) by												
	8	Material Handler												

FIGURE 9-8

PROCESS OR OPERATION ANALYSIS CHART

CHART

~~PROCESS.~~ ~~OPERATION.~~ FASTENER: Molded Plastic Spring-Lock PART: Stainless Steel Wire PRESENT METHOD ~~PROPOSED METHOD~~

SUMMARY

SHEET NO. 1 OF 2 SHEETS

	PRESENT L. H.	PRESENT R. H.	PROPOSED L. H.	PROPOSED R. H.	SAVING
No. of O		2			
No. of □		1			
No. of o		16			
No. of ∇		13			
Tot. Steps		32			
Tot. Dist.		1046 feet			
Cyc. Time					
Cost/Pc.					

DATE

DEPT.:

OPERATOR:

OBSERVER:

REMARKS:

APPROVED:

STEP	DIST. Ft. ~~In.~~	PRESENT METHOD	O	□	o	∇		O	□	o	∇		DIST. Ft. In.	TIME Hrs. Min.
1		Coiled stainless steel roll in supply												
2	212	To Straightening Machine												
3		Waits need												
4	6	Placed on Straightening Machine												
5		Straightened												
6		Waits Material Handler to remove from machine												
7	66	To Press Area												
8		Waits need												
9		Placed on machine, Insert Press, by												
	12	Material Handler												
10		Pressed into shape with Flat Wire												
11	1	Drops into Small Tote Pan												
12		Waits accumulation in Small Tote Pan												
13		Emptied from Small Tote Pan into Large												
	2	Tote Pan by Operator												
14		Waits pickup by Material Handler												
15	196	To Shipping												
16		Waits pickup												
17		To Plating Plant, Albany												

FIGURE 9-9

~~PROCESS:~~ FASTENER: Molded Plastic Spring-Lock
~~OPERATION:~~ PART: Stainless Steel Wire

PRESENT METHOD
~~PROPOSED METHOD~~

STEP	DIST. Ft. In.	PRESENT METHOD	O	□	o	∇		O	□	o	∇		DIST. Ft. In.	TIME Hrs. Min.
18		To Receiving, Simmons Fastener												
19		Waits pickup												
20	160	To Storage in Inspection Area												
21		Waits processing												
22	28	To Inspection Bench												
23		Inspected for poor plating, breaks, distortions, etc.												
24	1	To small container												
25		Waits accumulation in Small Container												
26	2	To Large Tote Pan												
27		Waits accumulation in Large Tote Pan												
28	160	To Shipping												
29		Waits order from Thermo Plastic												
30		To Thermo Plastic												
31		To Receiving, Simmons Fastener												
32		Waits processing for shipment												

FIGURE 9-9
(CONT.)

PROCESS ANALYSIS SUMMARY OF COMPONENTS FOR "PLASTIC SPRING LOCK"

Components	○ Operations	□ Inspections	○ Trans-portations	▽ Delays/Storages	Distance (Feet)
Flat Wire	0	0	2	2	200
S.S. Wire	2	1	16	13	1046
TOTALS	2	1	18	15	1246

FIGURE 9-10

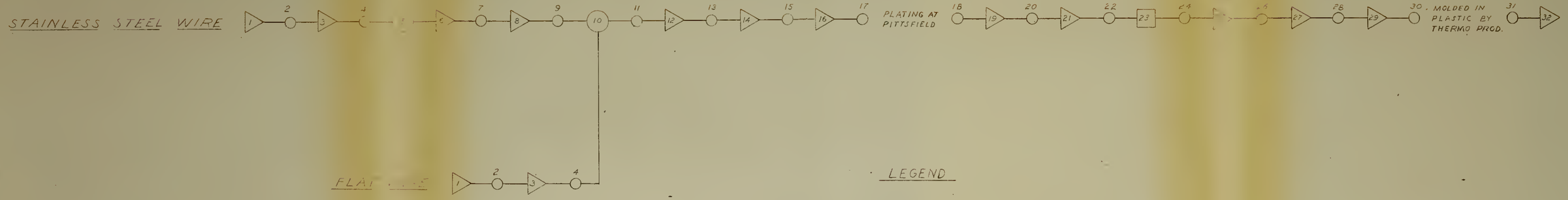


FIGURE 9-11

PROCESS FLOW CHART
FOR
PLASTIC SPRING-LOCKS
(PRESENT METHOD)

DATE: 10 MARCH 1959

NOTE: NUMBERS & SYMBOLS CORRESPOND TO THE STEPS IN THE PROCESS ANALYSIS CHARTS FIGURES 9-8 AND 9-9.

PROCESS OR OPERATION ANALYSIS CHART

CHART

~~PROCESS.~~ FASTENER: No. 2 Standard Link-Lock PRESENT METHOD
~~OPERATION.~~ PART: Hexagon Head Cam ~~PROPOSED METHOD~~

SUMMARY

SHEET NO. 1 OF 2 SHEETS

	PRESENT		PROPOSED		SAVING
	L. H.	R. H.	L. H.	R. H.	
No. of O	6				
No. of □	1				
No. of o	15				
No. of ∇	24				
Tot. Steps	46				
Tot. Dist.	1254 feet				
Cyc. Time					
Cost/Pc.					

DATE

DEPT.:

OPERATOR:

OBSERVER:

REMARKS:

APPROVED:

STEP	DIST. Ft. ~~In.~~	PRESENT METHOD	O	□	o	∇	O	□	o	∇	DIST. Ft. In.	TIME Hrs. Min.
1		Purchased										
2		To Simmons Fastener Receiving										
3		Waits pickup										
4	164	To Inspection Table										
5		Waits processing										
6		Inspected for Quality										
7		Waits completion of batch										
8		Waits pickup										
9	72	To Storage										
10		Waits need										
11	100	To 2 Spindle Drill Press (auto Feed)										
12		Waits Processing										
13		2 Horizontal holes Drilled										
14		Waits completion of batch										
15		Waits pickup										
16	48	To Wash										
17		Waits processing										
18		Washed										
19		Waits pickup										
20	108	To 1 Spindle Drill Press										

FIGURE 9-12

~~PROCESS.~~ FASTENER: No. 2 Standard Link-Lock PRESENT METHOD
~~OPERATION.~~ PART: Hexagon Head Cam ~~PROPOSED METHOD~~

STEP	DIST. Ft. ~~In.~~	PRESENT METHOD	O	□	o	∇		O	□	o	∇		DIST. Ft. In.	TIME Hrs. Min.
21		Waits processing												
22		Vertical Rivet Hole drilled												
23		Waits completion of batch												
24		Waits pickup												
25	72	To Clip Tool (near Receiving)												
26		Waits processing												
27		1 Retainer Hole Clipped												
28		Waits completion of batch												
29		Waits pickup												
30	164	To Wash & Tumble												
31		Waits processing												
32		Wash & Tumbled (Deburred)												
33		Waits pickup												
34	236	To Shipping												
35		Waits pickup												
36		To Plating (Pittsfield)												
37		To Simmons Fastener Receiving												
38		Waits pickup												
39	212	To Assembly Bench (Adjacent Office)												
40		Waits Processing												
41		Wing, Cam, & Spring Assembled												
42		Waits completion of batch												
43		Waits pickup												
44	76	To Assembly Press (Denison)												
45		Waits processing												
46	2	To Assembly												

FIGURE 9-12
(CONT.)

PROCESS OR OPERATION ANALYSIS CHART

CHART

~~PROCESS.~~ ~~OPERATION:~~ FASTENER: No. 2 Standard Link-Lock PART: Anchor Plate — PRESENT METHOD ~~PROPOSED METHOD~~

SUMMARY

SHEET NO. 1 OF 1 SHEETS

	PRESENT L. H.	PRESENT R. H.	PROPOSED L. H.	PROPOSED R. H.	SAVING
No. of O	2				
No. of □	0				
No. of o	7				
No. of ∇	9				
Tot. Steps	18				
Tot. Dist.	642 feet				
Cyc. Time					
Cost/Pc.					

DATE

DEPT.:

OPERATOR:

OBSERVER:

REMARKS:

APPROVED:

STEP	DIST. Ft. ~~In.~~	PRESENT METHOD	O	□	o	∇	O	□	o	∇		DIST. Ft. In.	TIME Hrs. Min.
1		Coiled Steel Roll in Supply											
2	192	To 50-Ton Thomas Punch Press											
3		Awaits need											
4		Punched into shape											
5		Waits for completion of batch											
6		Waits pickup											
7	68	To Wash & Tumble											
8		Waits processing											
9		Washed & Tumbled (Deburred)											
10		Waits pickup											
11	236	To Shipping											
12		Waits pickup											
13		To Plating (Pittsfield)											
14		To Simmons Fastener Receiving											
15		Waits Pickup											
16	98	To Storage Area in Plant											
17		Awaits need											
18	48	To assembly											

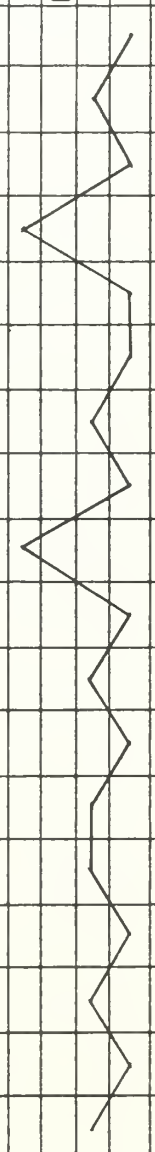


FIGURE 9-13

PROCESS OR OPERATION ANALYSIS CHART

CHART

PROCESS: FASTENER: No. 2 Standard Link-Lock PRESENT METHOD
OPERATION: PART: Anchor Plate Rivet ~~PROPOSED METHOD~~

SUMMARY

SHEET NO. 1 OF 1 SHEETS

	PRESENT		PROPOSED		SAVING
	L. H.	R. H.	L. H.	R. H.	
No. of O		0			
No. of □		0			
No. of o		6			
No. of ∇		5			
Tot. Steps		11			
Tot. Dist.		384			
Cyc. Time					
Cost/Pc.					

DATE

DEPT.:

OPERATOR:

OBSERVER:

REMARKS:

APPROVED:

STEP	DIST. Ft. ~~In.~~	PRESENT METHOD	O	□	o	∇		O	□	o	∇		DIST. Ft. In.	TIME Hrs. Min.
1		Purchased												
2	104	To Supply												
3		Waits processing												
4	104	To Shipping												
5		Waits Pickup												
6		To Plating (Pittsfield)												
7		To Simmons Fastener Receiving												
8		Waits pickup												
9	104	To Storage												
10		Waits need												
11	72	To Assembly												

FIGURE 9-14

PROCESS OR OPERATION ANALYSIS CHART

CHART

~~PROCESS.~~ ~~OPERATION.~~ FASTENER: No. 2 Standard Link-Lock PRESENT METHOD
PART: Wing ~~PROPOSED METHOD~~

SUMMARY SHEET NO. 1 OF 1 SHEETS

	PRESENT L. H.	PRESENT R. H.	PROPOSED L. H.	PROPOSED R. H.	SAVING
No. of O		2			
No. of □		0			
No. of o		7			
No. of ∇		9			
Tot. Steps		18			
Tot. Dist.		768			
Cyc. Time					
Cost/Pc.					

DATE
DEPT.:
OPERATOR:
OBSERVER:
REMARKS:
APPROVED:

STEP	DIST. Ft. ~~In.~~	PRESENT METHOD	O	□	o	∇	O	□	o	∇	DIST. Ft. In.	TIME Hrs. Min.
1		Coiled Steel Roll in Supply										
2	264	To 60-Ton Toledo Punch Press										
3		Awaits Need										
4		Punched into shape										
5		Waits completion of batch										
6		Waits pickup										
7	62	To Wash & Tumble										
8		Waits processing										
9		Washed & Tumbled (Deburred)										
10		Waits pickup										
11	236	To Shipping										
12		Waits pickup										
13		To Plating (Pittsfield)										
14		To Simmons Fastener Receiving										
15		Waits Pickup										
16	98	To Storage Area in Plant										
17		Awaits need										
18	108	To Assembly										

FIGURE 9-15

PROCESS OR OPERATION ANALYSIS CHART

CHART

~~PROCESS:~~ FASTENER: No. 2 Standard Link-Lock — PRESENT METHOD
~~OPERATION:~~ PART: Male Slide — ~~PROPOSED METHOD~~

SUMMARY — SHEET NO. 1 OF 2 SHEETS

	PRESENT L. H.	PRESENT R. H.	PROPOSED L. H.	PROPOSED R. H.	SAVING
No. of O		3			
No. of □		10			
No. of o		11			
No. of ∇		13			
Tot. Steps		27			
Tot. Dist.		1156 feet			
Cyc. Time					
Cost/Pc.					

DATE
DEPT.:
OPERATOR:
OBSERVER:
REMARKS:
APPROVED:

STEP	DIST. Ft. ~~In.~~	PRESENT METHOD	O	□	o	∇						DIST. Ft. In.	TIME Hrs. Min.
1		Coiled steel roll in supply											
2	232	To 30-Ton Toledo Punch Press											
3		Awaits Need											
4		Punched into shape											
5		Waits for completion of batch											
6		Waits pickup											
7	50	To Wash and Tumble											
8		Waits processing											
9		Washed & Tumbled (Deburred)											
10		Waits pickup											
11	236	To Shipping											
12		Waits pickup											
13		To Heat Treat(Ramsey Products, Albany)											
14		To Simmons Fastener Receiving											
15		Waits pickup											
16	236	To Tumble											
17		Waits processing											
18		Tumbled (Descaled)											
19		Waits pickup											
20	236	To Shipping											

FIGURE 9-16

~~PROCESS:~~ FASTENER: No. 2 Standard Link-Lock PRESENT METHOD
~~OPERATION:~~ PART: Male Slide ~~PROPOSED METHOD~~

STEP	DIST. Ft. ~~In.~~	PRESENT METHOD	O	□	o	∇		O	□	o	∇		DIST. Ft. In.	TIME Hrs. Min.
21		Waits pickup												
22		To Plating (Pittsfield)												
23		To Simmons Fastener Receiving												
24		Waits pickup												
25	98	To Storage Area in Plant												
26		Awaits need												
27	68	To Assembly												

FIGURE 9-16
(CONT.)

PROCESS OR OPERATION ANALYSIS CHART

CHART

~~PROCESS.~~ FASTENER: No. 2 Standard Link-Lock PRESENT METHOD
~~OPERATION.~~ PART: Figure 8 Cam Link ~~PROPOSED METHOD~~

SUMMARY

SHEET NO. 1 OF 2 SHEETS

	PRESENT		PROPOSED		SAVING
	L. H.	R. H.	L. H.	R. H.	
No. of O		3			
No. of □		0			
No. of o		11			
No. of ∇		13			
Tot. Steps		27			
Tot. Dist.		1172			
Cyc. Time					
Cost/Pc.					

DATE

DEPT.:

OPERATOR:

OBSERVER:

REMARKS:

APPROVED:

STEP	DIST. Ft. ~~In.~~	PRESENT METHOD	O	□	o	∇		O	□	o	∇		DIST. Ft. In.	TIME Hrs. Min.
1		Coiled Steel Roll in Supply												
2	212	To 21-Ton Bliss Punch Press												
3		Waits need												
4		Punched into shape												
5		Waits completion of batch												
6		Waits pickup												
7	76	To Wash & Tumble												
8		Waits processing												
9		Washed & Tumbled (Deburred)												
10		Waits pickup												
11	236	To Shipping												
12		Waits pickup												
13		To Heat Treat, Albany												
14		To Simmons Fastener Receiving												
15		Waits pickup												
16	236	To Tumble												
17		Waits processing												
18		Tumbled (Descaled)												
19		Waits pickup												
20	236	To Shipping												

FIGURE 9-17

~~PROCESS~~ FASTENER: No. 2 Standard Link-Lock PRESENT METHOD
OPERATION: PART: Figure 8 Cam Link ~~PROPOSED METHOD~~

STEP	DIST. Ft. ~~In.~~	PRESENT METHOD	O	□	o	∇		O	□	o	∇		DIST. Ft. In.	TIME Hrs. Min.
21		Waits pickup												
22		To Plating (Pittsfield)												
23		To Simmons Fastener Receiving												
24		Waits pickup												
25	104	To Storage Area in Plant												
26		Awaits need												
27	72	To Assembly Table												

FIGURE 9-17
(CONT.)

PROCESS OR OPERATION ANALYSIS CHART

CHART

~~PROCESS:~~ FASTENER: No. 2 Standard Link-Lock — PRESENT METHOD
~~OPERATION:~~ PART: Stainless Steel Cam Rivet — ~~PROPOSED METHOD~~

SUMMARY

SHEET NO. ____ OF ____ SHEETS

	PRESENT		PROPOSED		SAVING
	L. H.	R. H.	L. H.	R. H.	
No. of O		0			
No. of □		0			
No. of o		3			
No. of ∇		1			
Tot. Steps		4			
Tot. Dist.		184			
Cyc. Time					
Cost/Pc.					

DATE ____

DEPT.: ____

OPERATOR: ____

OBSERVER: ____

REMARKS: ____

APPROVED: ____

STEP	DIST. Ft. ~~In.~~	PRESENT METHOD	O	□	o	∇		O	□	o	∇		DIST. Ft. In.	TIME Hrs. Min.
1		Purchased												
2	112	To Supply												
3		Waits need												
4	72	To Assembly												

FIGURE 9-18

PROCESS OR OPERATION ANALYSIS CHART

CHART

PROCESS: FASTENER: No. 2 Standard Link-Lock PRESENT METHOD
OPERATION: PART: Stainless Steel Wing Spring ~~PROPOSED METHOD~~

SUMMARY

SHEET NO. ____ OF ____ SHEETS

	PRESENT		PROPOSED		SAVING
	L. H.	R. H.	L. H.	R. H.	
No. of O		0			
No. of □		0			
No. of o		3			
No. of ∇		1			
Tot. Steps		4			
Tot. Dist.		176			
Cyc. Time					
Cost/Pc.					

DATE ____

DEPT.: ____

OPERATOR: ____

OBSERVER: ____

REMARKS: ____

APPROVED: ____

STEP	DIST. Ft. ~~In.~~	PRESENT METHOD	O	□	o	∇		O	□	o	∇		DIST. Ft. In.	TIME Hrs. Min.
1		Purchased												
2	40	To Supply												
3		Waits need												
4	136	To Assembly												

FIGURE 9-19

PROCESS OR OPERATION ANALYSIS CHART

CHART

~~PROCESS:~~ FASTENER: No. 2 Standard Link-Lock — PRESENT METHOD
~~OPERATION:~~ PART: Female Slide Housing — ~~PROPOSED METHOD~~

SUMMARY

SHEET NO. 1 OF 3 SHEETS

	PRESENT L. H.	PRESENT R. H.	PROPOSED L. H.	PROPOSED R. H.	SAVING
No. of O	11				
No. of □	1				
No. of o	19				
No. of ∇	30				
Tot. Steps	61				
Tot. Dist.	1556				
Cyc. Time					
Cost/Pc.					

DATE

DEPT.:

OPERATOR:

OBSERVER:

REMARKS:

APPROVED:

STEP	DIST. Ft. ~~In.~~	PRESENT METHOD	O	□	o	∇		O	□	o	∇		DIST. Ft. In.	TIME Hrs. Min.
1		Coiled Steel Roll in Supply												
2	148	To 50-Ton Thomas Punch Press												
3		Waits Need												
4		Punched & Formed												
5		Awaits completion of batch												
6		Waits pickup												
7	84	To Wash & Tumble												
8		Waits processing												
9		Washed & Tumbled (deburred)												
10		Waits pickup												
11	236	To Shipping												
12		Waits pickup												
13		To Heat Treat, Albany												
14		To Simmons Fastener Receiving												
15		Waits pickup												
16	236	To Tumble												
17		Waits processing												
18		Tumbled (Descaled)												
19		Waits pickup												
20	236	To Shipping												

FIGURE 9-20

~~PROCESS:~~ FASTENER: No. 2 Standard Link-Lock PRESENT METHOD
~~OPERATION:~~ PART: Female Slide Housing ~~PROPOSED METHOD~~

STEP	DIST. Ft. In.	PRESENT METHOD	O	□	o	∇		O	□	o	∇		DIST. Ft. In.	TIME Hrs. Min.
21		Waits pickup												
22		To Plating (Pittsfield)												
23		To Simmons Fastener Receiving												
24		Waits pickup												
25	112	To storage in plant												
26		Awaits need												
27	176	To Assembly Press (Denison)												
28		Waits processing												
29		Assembled to Cam Wing												
30		Waits completion of batch												
31		Waits pickup												
32	112	To Hand Assembly Table												
33		Awaits need												
34		Greased												
35		Waits processing												
36		Hand assembled to Fig. 8 Cam link &												
		Male Slide with Rivet												
37	8	To Spin Rivet Press												
38		Waits processing												
39		Rivet Spun in												
40		Waits completion of batch												
41		Waits pickup												
42	16	To Table Press												
43		Waits processing												
44		Riveted to Anchor Plate												
45		Waits completion of batch												
46		Waits pickup												
47	20	To Punch Press (any available)												

FIGURE 9-20
(CONT.)

~~PROCESS.~~ FASTENER: No. 2 Standard Link-Lock PRESENT METHOD
~~OPERATION.~~ PART: Female Slide Housing ~~PROPOSED METHOD~~

STEP	DIST. Ft. ~~In.~~	PRESENT METHOD	O	□	o	∇		O	□	o	∇		DIST. Ft. In.	TIME Hrs. Min.
48		Waits processing												
49		Sized on Punch Press												
50		Waits completion of batch												
51		Waits pickup												
52	16	To Inspection Table												
53		Waits processing												
54		Inspected for Oper. and Plating												
55	8	To Hand deburring of Cam Rivet												
56		Waits processing												
57		Cam Rivet Deburred with hammer												
58	4	To Degreasing & Boxing												
59		Waits processing												
60		Degreased by hand wiping and boxed												
61	144	To shipping												

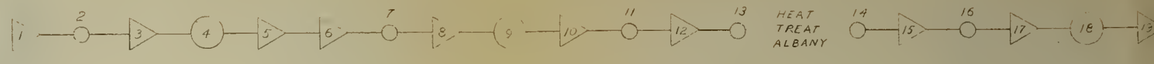
FIGURE 9-20
(CONT.)

PROCESS ANALYSIS SUMMARY OF NUMBER 2 STANDARD LINK LOCK, PRESENT METHOD

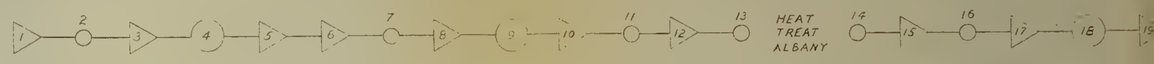
Components	○ Operations	□ Inspections	○ Trans-portations	▽ Delays/Storages	Distance (Feet)
Hex. Head Cam	6	1	15	24	1254
Anchor Plate	2	0	7	9	642
Anchor Rivet	0	0	6	5	384
Wing	2	0	7	9	768
Male Slide	3	0	11	13	1156
Cam Link	3	0	11	13	1172
Cam Rivet	0	0	3	1	184
Wing Spring	0	0	3	1	176
Female Slide	11	1	19	30	1556
TOTALS	27	2	82	105	7292

FIGURE 9-21

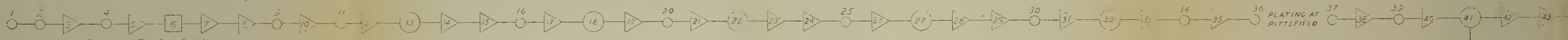
FIGURE "8" CAM LINK



MALE SLIDE

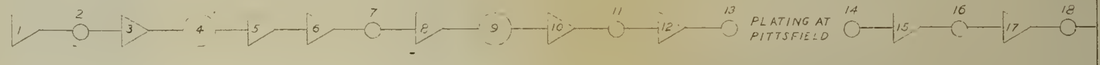


FEMALE SLIDE HOUSING

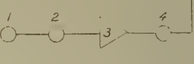


HEX HEAD CAM

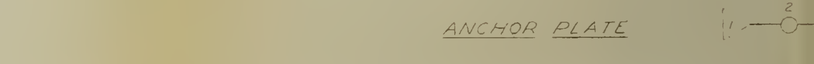
WING



WING SPRING



ANCHOR PLATE



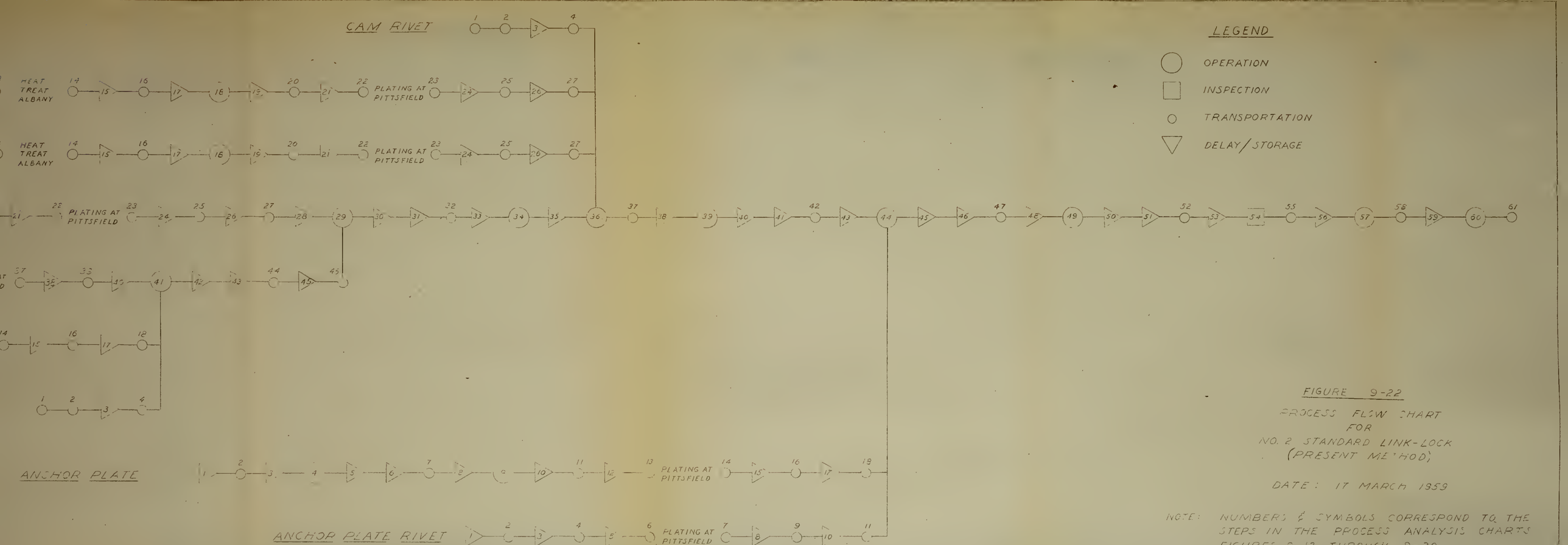


FIGURE 9-22

PROCESS FLOW CHART
FOR
NO. 2 STANDARD LINK-LOCK
(PRESENT METHOD)

DATE: 17 MARCH 1959

NOTE: NUMBERS & SYMBOLS CORRESPOND TO THE STEPS IN THE PROCESS ANALYSIS CHARTS FIGURES 9-12 THROUGH 9-20.

thesA164
A management survey ... Simmons Machine
3 2768 001 90879 1
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